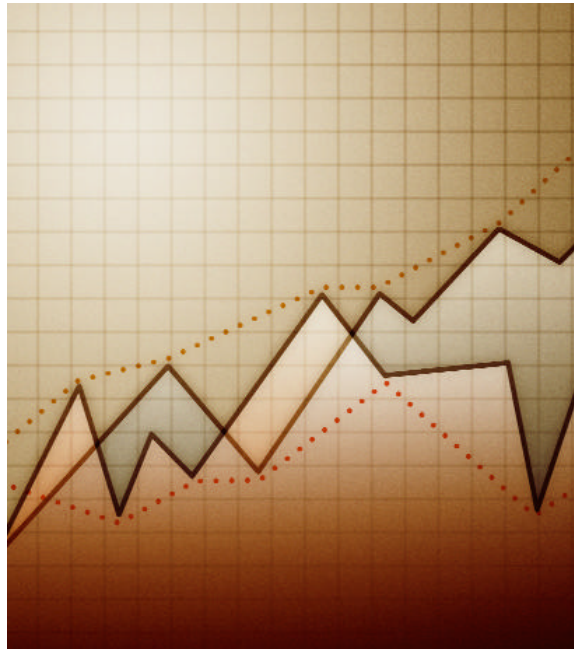


Final Report

California Recycling Economic Information Study

Prepared for the California Integrated Waste Management Board
by The National Recycling Coalition
in association with R. W. Beck, Inc.



July 2001



CALIFORNIA RECYCLING ECONOMIC INFORMATION STUDY

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OVERVIEW

This report presents the results of the California Recycling Economic Information (REI) Study that was commissioned by the California Integrated Waste Management Board. This study was conducted by R. W. Beck, Inc. with economic modeling provided by Iowa State University as part of the National Recycling Coalition's U.S. Recycling Economic Information (US REI) Study. Data from the California REI study was incorporated into the US REI Study results. This Executive Summary contains the results of the study. The remainder of the report is dedicated to a complete and thorough documentation of the results and the methodology used in producing them.

The methodology used for this study conforms to the methodology developed by the Northeast Recycling Council on behalf of the US EPA for gathering economic data on the recycling and reuse industry.¹ Recycling establishments that use a combination of recycled and virgin feedstock in making their products were defined to be recycling and reuse industry establishments for the purposes of this project.²

The goal of the study was to document the size of the recycling and reuse industry by first determining direct economic information for each of twenty-six categories of recycling and reuse establishments. The direct economic values that were measured included:

- Number of establishments;
- Employment;
- Annual payroll;
- Annual receipts; and
- Annual throughput (for recycling categories).

Next, similar information was estimated for four categories of supporting establishments intimately involved in the recycling and reuse industry. Finally, the broader effect of recycling and reuse businesses and their employees on the economy was derived through economic modeling using direct data as inputs. This information included:

- Indirect economic values (inter-industry linkages as measured by purchase of intermediate commodities);
- Induced economic values (personal spending by employees of direct and indirect establishments);
- Multipliers to calculate total economic values (the sum of direct, indirect, and induced) from direct economic values; and
- Tax revenues attributable to the recycling and reuse industry.

SIZE OF THE RECYCLING AND REUSE INDUSTRY

California's recycling and reuse industry is highly diverse in terms of which recovered materials are utilized, average establishment size, and which technologies are employed. Its

¹ Northeast Recycling Council, *Recycling Economic Information Study*, June 2000.

² In general, entire-establishment economic data were counted. However, economic data were adjusted to eliminate virgin-only establishment data, remove the economic activity associated with virgin-material preparation at mixed virgin and recycled feedstock establishments, and remove the economic activity of manufacturing steps that are unrelated to recycling (e.g., converting intermediate products to finished goods).

EXECUTIVE SUMMARY

recycling sector includes long-established sub-industries such as paper making, as well as new entrepreneurial ventures such as composting and recycled rubber product manufacturing. The reuse and re-manufacturing sector encompasses a diverse mix of establishments including wood reuse (e.g., pallet rebuilders, etc.), tire retreaders, and electronic appliance demanufacturers. This size and diversity of California's recycling and reuse industry can be seen in Table ES-1, which presents estimates for twenty-six categories of establishments.

TABLE ES-1
SUMMARY OF ESTIMATES OF DIRECT ECONOMIC ACTIVITY

ANNUAL PAYROLL AND ESTIMATED RECEIPTS ARE IN \$1,000. THROUGHPUT IS IN THOUSANDS OF TONS.³

Business Category	Data Type	Estimates of Total Recycling and Reuse-Related Economic Activity
Recycling Industry Economic Activity		
1. Government Staffed Collection	Establishments	198
	Employment	1,900
	Annual Payroll	65,740
	Estimated Receipts	130,722
	Estimated Throughput	5,269
2. Private Staffed Collection	Establishments	323
	Employment	3,100
	Annual Payroll	107,260
	Estimated Receipts	213,283
	Estimated Throughput	34,381
3. Compost and Miscellaneous Organics Producers	Establishments	162
	Employment	1,892
	Annual Payroll	46,119
	Estimated Receipts	304,722
	Estimated Throughput	9,208
4. Materials Recovery Facilities (MRF's)	Establishments	47
	Employment	2,606
	Annual Payroll	49,986
	Estimated Receipts	206,424
	Estimated Throughput	3,625
5. Recyclable Material Wholesalers	Establishments	1,000
	Employment	13,710
	Annual Payroll	344,894
	Estimated Receipts	4,549,177
	Estimated Throughput	26,817
6. Glass Container Manufacturing Plants	Establishments	8
	Employment	3,013
	Annual Payroll	122,890
	Estimated Receipts	651,773
	Estimated Throughput	644
7. Glass Product Producers (other recycled uses)	Establishments	9
	Employment	697
	Annual Payroll	8,233
	Estimated Receipts	52,749
	Estimated Throughput	100
8. Nonferrous Secondary Smelting and Refining Mills	Establishments	43
	Employment	1,597
	Annual Payroll	62,504
	Estimated Receipts	707,670
	Estimated Throughput	281

³ Throughput is amount of recovered material recycled and includes manufacturing scrap sent for recycling. It excludes materials prepared for fuel use and in-house process scrap returned to the manufacturing process. Throughput estimates are not summed to avoid triple counting at collection, processing, and manufacturing stages.

Business Category	Data Type	Estimates of Total Recycling and Reuse-Related Economic Activity
9. Nonferrous Product Producers	Establishments	18
	Employment	1,467
	Annual Payroll	46,998
	Estimated Receipts	329,511
	Estimated Throughput	107
10. Nonferrous Foundries	Establishments	166
	Employment	4,550
	Annual Payroll	133,746
	Estimated Receipts	434,161
	Estimated Throughput	33
11. Paper, Paperboard, and Deinked Market Pulp Mills	Establishments	24
	Employment	2,940
	Annual Payroll	149,712
	Estimated Receipts	1,112,318
	Estimated Throughput	2,319
12. Paper-based Product Manufacturers	Establishments	16
	Employment	520
	Annual Payroll	15,713
	Estimated Receipts	104,528
	Estimated Throughput	196
13. Pavement Mix Producers (asphalt and aggregate)	Establishments	15
	Employment	228
	Annual Payroll	2,990
	Estimated Receipts	41,370
	Estimated Throughput	2,128
14. Plastics Reclaimers	Establishments	63
	Employment	1,499
	Annual Payroll	43,090
	Estimated Receipts	126,276
	Estimated Throughput	234
15. Plastics Converters	Establishments	309
	Employment	16,546
	Annual Payroll	503,281
	Estimated Receipts	2,476,497
	Estimated Throughput	229
16. Rubber Product Manufacturers	Establishments	15
	Employment	271
	Annual Payroll	9,363
	Estimated Receipts	56,880
	Estimated Throughput	19
17. Steel Mills	Establishments	1
	Employment	333
	Annual Payroll	17,316
	Estimated Receipts	129,036
	Estimated Throughput	675
18. Iron and Steel Foundries	Establishments	77
	Employment	4,916
	Annual Payroll	141,878
	Estimated Receipts	582,238
	Estimated Throughput	447
19. Other Recycling Processors/Manufacturers	Establishments	31
	Employment	871
	Annual Payroll	20,854
	Estimated Receipts	84,661
	Estimated Throughput	1,177
Recycling Industry Subtotals	Establishments	2,525
	Employment	62,657
	Annual Payroll (\$1,000)	1,892,568
	Estimated Receipts (\$1,000)	12,293,996

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Business Category	Data Type	Estimates of Total Recycling and Reuse-Related Economic Activity
Reuse and Remanufacturing Industry Economic Activity		
20. Computer and Electronic Appliance Demanufacturers	Establishments	34
	Employment	956
	Annual Payroll	24,696
	Estimated Receipts	125,120
	Estimated Throughput	N/A
21. Motor Vehicle Parts (used)	Establishments	773
	Employment	5,288
	Annual Payroll	108,208
	Estimated Receipts	653,927
	Estimated Throughput	N/A
22. Retail Used Merchandise Sales	Establishments	1,895
	Employment	13,845
	Annual Payroll	185,931
	Estimated Receipts	877,939
	Estimated Throughput	N/A
23. Tire Retreaders	Establishments	68
	Employment	893
	Annual Payroll	20,971
	Estimated Receipts	111,147
	Estimated Throughput	N/A
24. Wood Reuse	Establishments	32
	Employment	375
	Annual Payroll	4,503
	Estimated Receipts	29,088
	Estimated Throughput	N/A
25. Materials Exchange Services	Establishments	4
	Employment	19
	Annual Payroll	728
	Estimated Receipts	7,456
	Estimated Throughput	N/A
26. Other Reuse	Establishments	11
	Employment	212
	Annual Payroll	12,315
	Estimated Receipts	83,501
	Estimated Throughput	N/A
Reuse Industry Subtotals	Establishments	2,817
	Employment	21,588
	Annual Payroll (\$1,000)	357,352
	Estimated Receipts (\$1,000)	1,888,178
GRAND TOTALS		
Recycling and Reuse/Remanufacturing	Establishments	5,342
	Employment	84,245
	Annual Payroll (\$1,000)	2,249,919
	Estimated Receipts (\$1,000)	14,182,174

As Table ES-1 shows, California hosts approximately 5,300 recycling and reuse establishments employing 84,000 people generating an annual payroll of \$2.2 billion and \$14.2 billion in annual revenues.

Insight into California's recycling and reuse industry can be obtained by comparing the relative sizes of individual business categories and groups of categories that are related in terms of materials recycled or the industry sector in which they belong.

COMPARISON OF THE RECYCLING SECTORS TO THE REUSE SECTOR

A noticeable distinction exists between the recycling sectors as a group (collection, processing, and manufacturing) and the reuse sector in terms of the size of establishments and average annual payroll. The recycling establishments have an average of 25 employees each, with an average annual payroll per employee of \$30,000. Alternatively, the reuse sector is made up of smaller establishments – an average of 8 employees per establishment – with an average annual payroll of \$17,000 per employee. Although the reuse and remanufacturing sector comprises 53 percent of total establishments, it makes up only 26 percent of total employees, 16 percent of payroll, and 13 percent of receipts.⁴

It is assumed that differences in employee pay between recycling sector and reuse sector establishments closely follow the level of skill and training required of employees. Recycling manufacturing, which contributes heavily to the overall recycling statistics, generally requires employees of higher skill and training than is normally required of employees of reuse establishments. Employees of higher skill and training are paid more than employees of lesser skill and training. It should be noted that remanufacturing jobs, which were not well-characterized by this study, are more likely to have similar skill and training requirements to recycling manufacturing jobs and would pay higher wages than the average reuse sector job.

The difference in average employees per establishment between the recycling and reuse sectors can come from several sources, although two are most likely: (1) whether continuous production processes are employed; and (2) whether economies of scale produce improved production efficiency. Continuous production processes are normally employed to save energy, avoid production startup/shutdown inefficiencies, or cover high monthly fixed costs (such as capital equipment finance costs) by increasing daily production and revenues. Establishments that operate three shifts per day employ more persons than establishments of similar hourly production capacity that operate one shift per day. Processes where economies of scale reduce unit costs apply to those instances where overhead costs are significantly streamlined or where larger-sized capital equipment is more efficient than smaller-sized equipment. Because the capital equipment and processes employed in recycling manufacturing favor continuous production and economies of scale, it is not unexpected that recycling establishments are on average larger than reuse sector establishments (which rely more heavily on manual labor).

COMPARISON OF RECYCLING COLLECTION AND PROCESSING TO RECYCLING MANUFACTURING

Recycling categories that are focused locally on recovering materials from commercial, industrial, and residential waste streams include establishments that collect and process recyclables for shipment to the recycling manufacturing industry. These local collection and processing establishments include:

- Government staffed residential curbside collection;
- Privately-staffed residential curbside collection;
- Compost and miscellaneous organics products producers;
- Materials recovery facilities; and

⁴ These reuse and remanufacturing figures are thought to represent the minimum amount of economic activity captured by the methodology because remanufacturing activities are often included with traditional manufacturing industries that were not included in this study. Several years ago Boston University estimated remanufacturing activities on the national level (Professor Robert T. Lund, *The Remanufacturing Industry: Hidden Giant*, 1996). That study suggested that reuse and remanufacturing categories may be as much as three times larger than that characterized by this study's methodology.

■ Recyclable material wholesalers.

Alternatively, establishments in the recycling manufacturing sector are considered to be downstream consumers of recovered materials who rely on local collectors and processors for their supply of materials. When the two groups are compared, local collection and processing make up approximately 28 percent of total recycling employment and 38 percent of receipts, whereas downstream manufacturing makes up the remaining 72 percent of employment and 62 percent of receipts. This suggests that public policy to encourage recycling and discourage disposal, in addition to public and private investment in local recyclables collection and processing infrastructure pays great dividends in supporting significant downstream private recycling economic activity.

COMPARISON OF INDUSTRY SECTOR SIZES

Figures ES-1 and ES-2 compare the relative sizes of the recycling collection, recycling processing, recycling manufacturing, and reuse/remanufacturing sectors of the industry. As Figures ES-1 and ES-2 show, the recycling manufacturing sector leads the recycling collection, recycling processing, and reuse sectors in size.

FIGURE ES-1
EMPLOYMENT BY INDUSTRY SECTOR

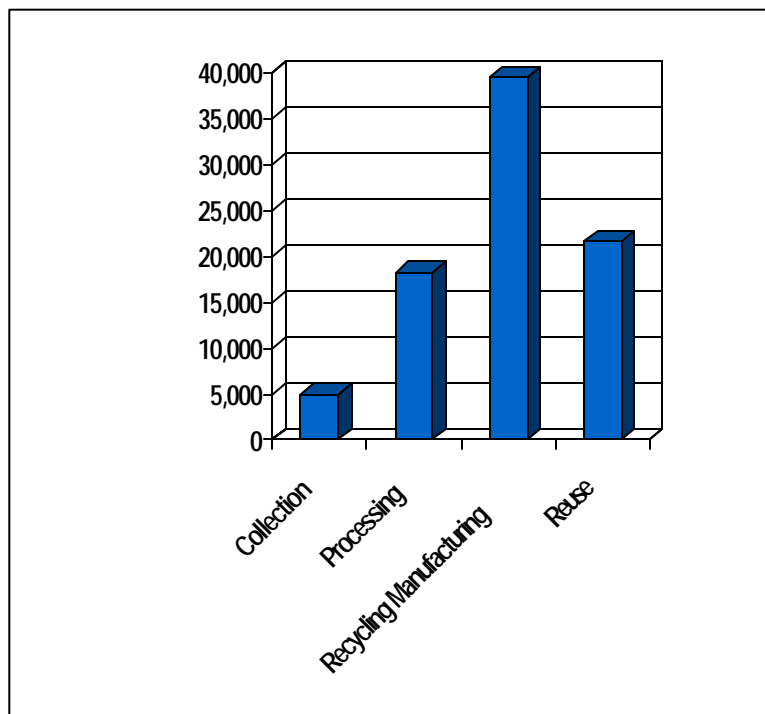
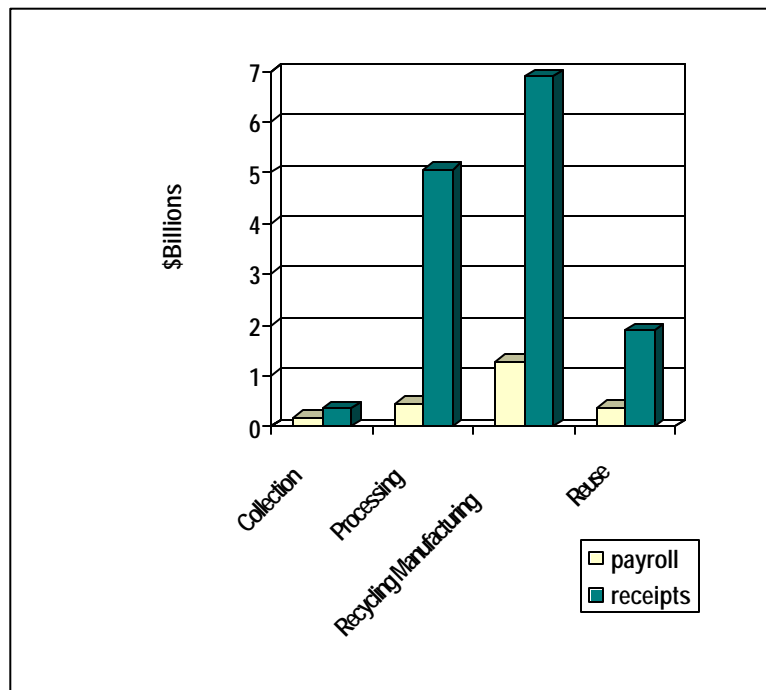


FIGURE ES-2
PAYROLL AND RECEIPTS BY INDUSTRY SECTOR



The ultimate value of a good or service is represented by the sale price of that good or service. Sales revenues, in turn, are used to employ persons and pay their wages, make payments on equipment, provide a return to owners and investors, and pay upstream supplier establishments for the value of their goods or services. The cost in terms of labor, equipment, etc. of performing a particular process is a measure of the value that is added by that particular process.

The progression in size from recycling collection to recycling processing to recycling manufacturing follows from the fact that those sectors are part of a chain where increasingly more value is added to the recovered material as it moves through the recycling chain. Initially, a relatively small amount of value is added by consolidation (collection). Processors invest significantly more expense (value) in the recovered material by sorting and densification. However, no transformation of the recovered material has yet occurred – the material has simply been concentrated. The greatest value is added in manufacturing where relatively useless raw materials of little value are made into useful products of considerable value.

Reuse and remanufacturing differ slightly in that they focus on consolidation and refurbishing of products (not raw materials) that still have significant value; however, the value reuse adds cannot exceed the value inherent in a new product made from raw materials – otherwise people would buy the new product. This limits the amount of value that can be added, and thus the size of the reuse sector compared to the manufacturing sector.

Figures ES-3 and ES-4 place this information into further perspective by showing how the size of California's major recyclable materials manufacturing industries compare to each other. As the figures show, reclaiming plastics and manufacturing recycled-content plastic products leads the other major materials groups.

FIGURE ES-3
RECYCLING MANUFACTURING INDUSTRY EMPLOYMENT BY MAJOR MATERIAL GROUP

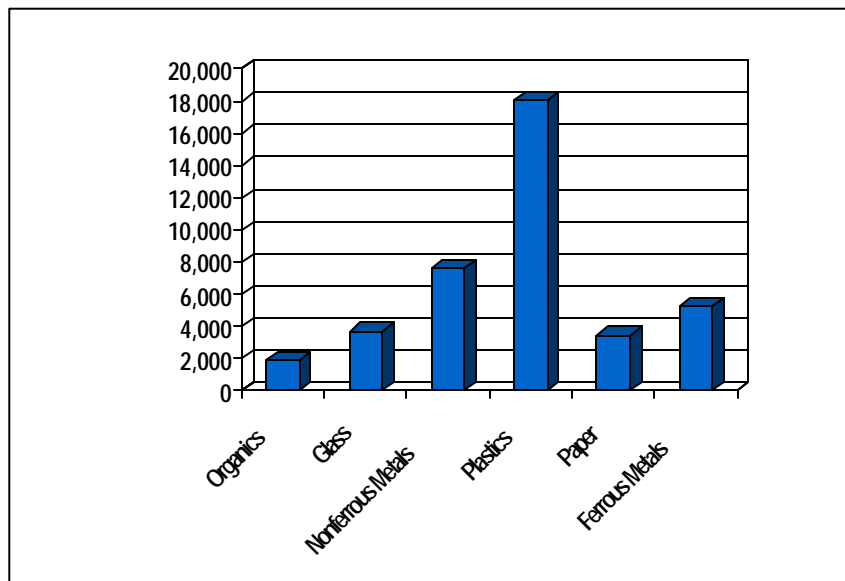
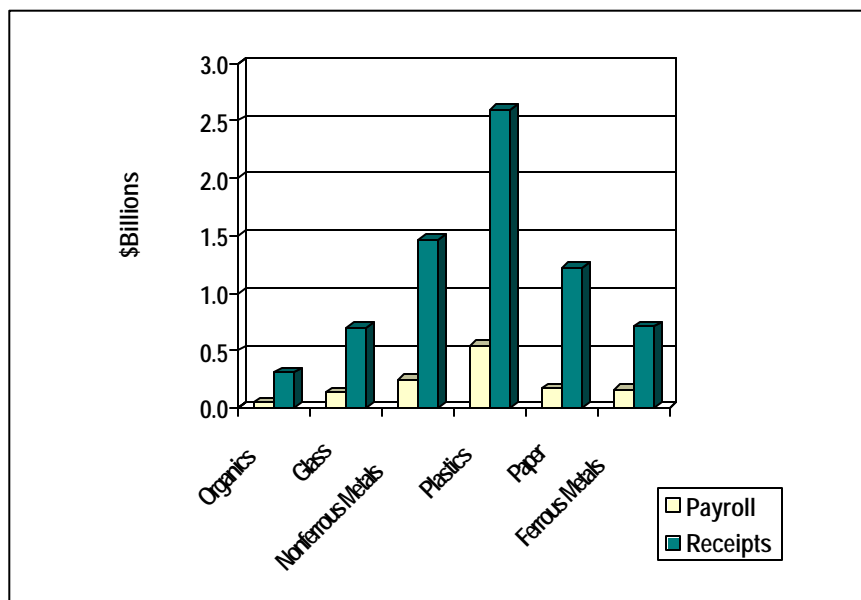


FIGURE ES-4
RECYCLING MANUFACTURING INDUSTRY PAYROLL AND RECEIPTS BY MAJOR MATERIAL GROUP



The amount of materials recycled, in combination with the underlying value of each raw material, help explain why some major material groups shown in Figures ES-3 and ES-4 rank higher than others. When large quantities of a high-value commodity are returned to the stream of commerce, the large amount of intrinsic value returned to the economy can support more jobs and economic activity than if a lesser amount or lower value commodity is returned to the stream of commerce. Plastics and non-ferrous metals are at the top end of the value scale, ferrous metals and paper are in the middle, and glass and compost are at the low end of the value scale.

When both amount recycled and value are considered together, the relative sizes of the various material groups can be explained. Similarly, estimates can be made of the economic impact that results from increased diversion of various materials.

LARGEST CONTRIBUTORS

Upon closer examination of Table ES-1, over half of the economic activity for the entire recycling and reuse industry is accounted for by the following four recycling manufacturing sector categories:

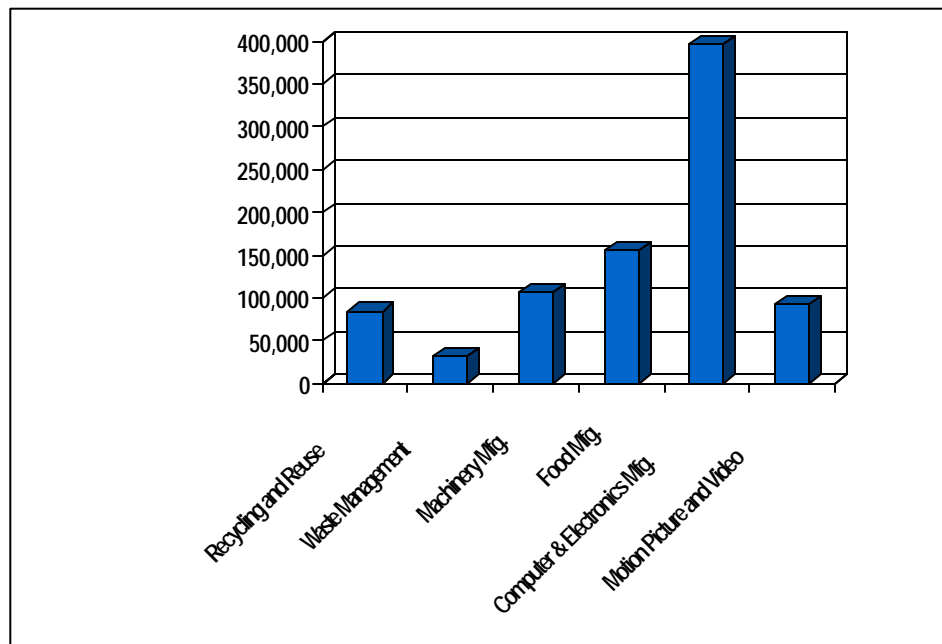
- Paper, paperboard, and deinked market pulp mills;
- Plastics converters;
- Recyclable material wholesalers; and
- Retail used merchandise sales.

These four categories alone account for 56 percent of all employees, 53 percent of wages, and 64 percent of total receipts.

THE RECYCLING AND REUSE INDUSTRY IN PERSPECTIVE

Figures ES-5, ES-6, and ES-7 show how the California's recycling and reuse industry compares to other select California industries.⁵

FIGURE ES-5
COMPARISON OF INDUSTRY EMPLOYMENT



⁵ Comparative industry information comes from the 1997 Economic Census (U.S. Census Bureau) for the following industries: Waste Management – NAICS 562 Waste Management and Remediation Services minus 56292 Materials Recovery Facilities; Machinery Manufacturing – NAICS 333; Food Manufacturing – NAICS; Computer and Electronics Manufacturing – NAICS 334; Motion Picture and Video Industries – NAICS 5121.

FIGURE ES-6
COMPARISON OF ANNUAL WAGES PER JOB

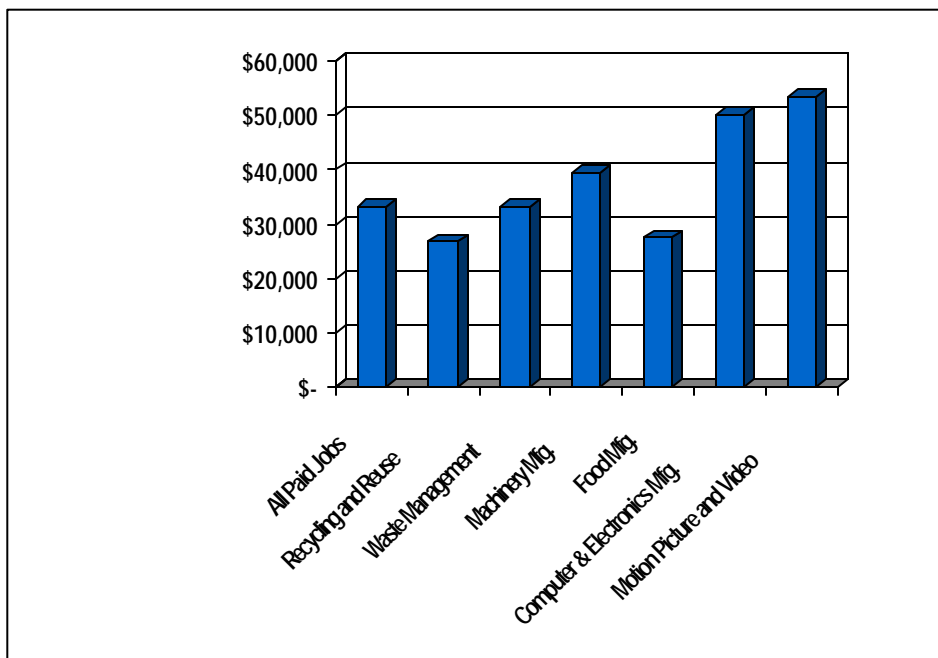
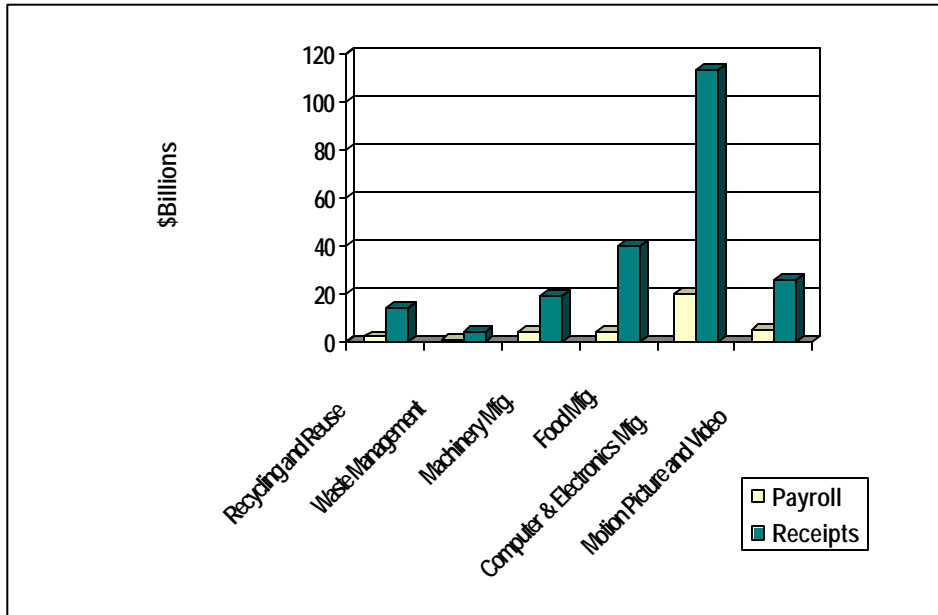


FIGURE ES-7
COMPARISON OF TOTAL WAGES AND SALES



As the figures show, the recycling and reuse industry is a significant industry as compared to other major California industries. Despite the fact that more discards are disposed than recycled, it is not surprising that the recycling and reuse industry is larger than the waste management industry. This is because recycling and reuse are inherently value-adding, whereas disposal is not, and value-adding processes support jobs and economic activity.

SUMMARY OF INDIRECT AND INDUCED ECONOMIC ACTIVITY

In addition to the twenty-six categories of direct recycling and reuse establishments, the study estimated data for four categories of support businesses that provide goods or services to recycling and reuse industry establishments as shown in Table ES-2. The general category Other Indirect Establishments shown in the table includes all other indirect establishments that provide goods or services (such as office supply companies, accounting firms, legal firms, building and landscape maintenance firms, etc.).

TABLE ES-2
ESTIMATES OF INDIRECT ECONOMIC ACTIVITY OF SELECT SUPPORT BUSINESS CATEGORIES

(ANNUAL PAYROLL AND ESTIMATED RECEIPTS ARE IN \$1,000)

Business Category	Data Type	Value
Recycling and Reuse Equipment Manufacturers ^[1]	Employment	3,010
	Annual Payroll	60,146
	Estimated Receipts	537,866
Consulting/Engineering ^[2]	Employment	507
	Annual Payroll	19,729
	Estimated Receipts	40,756
Transporters ^[2]	Employment	1,834
	Annual Payroll	194,065
	Estimated Receipts	283,917
Other Indirect Establishments ^[2]	Employment	44,884
	Annual Payroll	1,608,358
	Estimated Receipts	5,793,587
Support Businesses Totals	Employment	50,235
	Annual Payroll (\$1,000)	1,882,298
	Estimated Receipts (\$1,000)	6,656,126

Notes:

^[1] Data for Recycling and Reuse Equipment Manufacturers are based on a statistical analysis of survey results.

^[2] Data come from modeling output and reflect the indirect activity stimulated by the 26 direct categories of recycling and reuse establishments targeted by this study for direct data.

It is important to note that the data for Recycling and Reuse Equipment Manufacturers is based on a statistical analysis of survey data and therefore represents complete data for those types of establishments regardless of where they sell their equipment. Totals for the other categories represent indirect activity relating to only the 26 categories of recycling and reuse industry establishments that were investigated in this study.

The study also used economic modeling to estimate additional economic activity produced in California that is attributable to the recycling and reuse industry. Furthermore, state government tax revenues arising from the recycling and reuse industry were estimated. Table ES-3 shows summarized state government tax revenues for the direct economic activity of the 26 business categories.

TABLE ES-3
SUMMARY OF RECYCLING & REUSE INDUSTRY
DIRECT EFFECTS ON STATE GOVERNMENT REVENUES
(IN \$ MILLIONS)

Recycling Collection	17
Recycling Processing	44
Recycling Manufacturing	117
Reuse/Remanufacturing	40
Total	218

CONCLUSIONS

As shown by the following statistics, the recycling and reuse industry contributes significantly to California's economy:

- The recycling and reuse industry supports 1.3 percent of the paid jobs in California – 0.6 percent through direct employment, and 0.7 percent by industry and employee spending in the economy. ⁶
- Some 0.8 percent of the California gross state product is attributable to the recycling and reuse industry, with 0.3 percent provided directly by the industry. ⁶

As noted previously, investments at the local level in collection and processing of recyclables and public policies that favor recycling and reuse certainly support large private sector investments in downstream processing and manufacturing. However, further study is necessary to rigorously assess the impact of public policy on recycling economic activity and to document recycling and reuse industry growth over the baseline established in this report.

⁶ Gross state product data comes from the U.S. Bureau of Economic Analysis, "Gross State Product in Current Dollars, 1992-1998" table using data for 1997.

1.1 OVERVIEW

This report presents the results of the California Recycling Economic Information (REI) Study that was commissioned by the California Integrated Waste Management Board. The goal of the study was to document the size of the recycling and reuse industry by first determining direct economic information for each of twenty-six categories of recycling and reuse establishments. The direct economic values that were measured included:

- Number of establishments;
- Employment;
- Annual payroll;
- Annual receipts; and
- Annual throughput (for applicable categories).

Next, similar information was estimated for four categories of supporting establishments intimately involved in the recycling and reuse industry. Finally, the broader effect of recycling and reuse businesses and their employees on the economy was derived through economic modeling using direct data as inputs. This information included:

- Indirect economic values (inter-industry linkages as measured by purchase of intermediate commodities);
- Induced economic values (personal spending by employees of direct and indirect establishments);
- Multipliers to calculate total economic values (the sum of direct, indirect, and induced) from direct economic values; and
- State tax revenues attributable to the recycling and reuse industry.

1.2 COMPARISON TO SIMILAR STUDIES

The California REI study conforms to the methodology for gathering economic data on the recycling and reuse industries that was developed by the Northeast Recycling Council (NERC) on behalf of the U.S. Environmental Protection Agency. As a result, the information contained in this report is generally comparable to that of REI studies conducted for:

- The Northeast Recycling Council,⁷ including the ten-state region as a whole and state-level data for Delaware, Massachusetts, New Jersey, New York, Pennsylvania, and Vermont;
- The National Recycling Coalition, for the nation as a whole and states that commissioned state-level studies, including Florida, Indiana, Nebraska, and Ohio⁸; and

⁷ "Recycling Economic Information Study," Northeast Recycling Council, June 2000.

⁸ "US Recycling Economic Information Study," National Recycling Coalition, June 2001; "Florida Recycling Economic Information Study," Florida Department of Environmental Protection, June 2000; "Indiana Recycling Economic Information Study," Indiana Department of Commerce, May 2001; "Nebraska Recycling Economic Information Study," Nebraska Department of Economic Development, March 2001; "Ohio Recycling Economic Information Study," Ohio Department of Natural Resources, January 2001.

- Other states that conform to the specified REI methodology.⁹

At least seven other recycling economic information studies had been performed before NERC developed a standard REI study methodology. Although those existing studies quantified employment and most included other industry size estimates (such as annual sales or value-added), they used varying (and sometimes inconsistent) data collection methodologies and industry definitions. Therefore, care should be taken if attempting to compare the results of this study to previous studies. Table 1-1 lists the types of data collected in this study compared to three previous economic information studies.

TABLE 1-1
COMPARISON OF DATA PRESENTED IN OTHER RECYCLING ECONOMIC INFORMATION STUDIES

Name of Study	Types of Data Presented						
	Recycling Collection	Recycling Processing	Recycling End Use	Reuse	Support Businesses	Multipliers	Tax Revenues
California REI Study (2001)	●	●	●	●	●	●	●
Selected Previous Studies							
Assessment of Economic Impacts of Recycling in Iowa; Recycle Iowa Program (1996, 2001 Update)		●	●				●
Arizona Recycling Market Development Study; Arizona Department of Commerce (1996)	●	●	●			●	
Value Added to Recyclable Materials in the Northeast; NERC (1994)	●	●	●				

1.3 INTENDED USES FOR THE STUDY

Recycling and reuse businesses, like other businesses, provide a number of economic benefits, including: creating jobs, making investments, and paying taxes. This study and the economic benefit information it contains may be used as a:

- Reference for economic development agencies, entrepreneurs, and financiers to understand and evaluate recycling and reuse businesses;
- Reference for lawmakers to assist them in evaluating legislation that would affect recycling and reuse;
- Tool for recycling advocates to increase understanding of the industry, promote awareness of recycling and reuse, and target resources for growth; and
- Baseline of economic information to document future growth and development of the industry.

1.4 REPORT ORGANIZATION

This report is organized into the following sections:

1. **Introduction**, which provides a brief overview of the development of the REI study, comparison to similar studies, and intended uses of the study;

⁹ Illinois, Iowa, Minnesota, Missouri, and Wisconsin all conducted studies in 2000/2001 that made use of at least some of the tools and methodology found in "Recycling Economic Information Study", Northeast Recycling Council, June 2000.

2. **Data Characterization**, which briefly describes the development of the business categories, types of data, approaches to data development, and the included activities and boundaries of the study;
3. **Study Methodology**, which explains the methodology used in developing estimates for each category and data type;
4. **Study Results**, which presents detailed data tables and related notes for each sponsoring state and the region as a whole;
5. **Indirect and Induced Economic Information**, which presents the multipliers and related results of economic modeling; and
6. **Recommendations for Future Studies**, which provides suggestions for replication of the study.

The following appendices contain additional detail to support and further explain the methodology and results:

- A. Description of Recycling and Reuse Business Categories
- B. Evaluation of Data Sources
- C. Sample of Raw Data from U.S. Census Bureau's *Economic Census*
- D. Survey Materials
- E. Statistical Analysis of Survey Results
- F. Glossary of Terms

2.1 STUDY BOUNDARIES

Defining the recycling and reuse industry is complex. For example, one establishment may perform a variety of processing and/or manufacturing activities, only some of which are related to recycling or reuse. So the question arises whether the establishment should be included, and if so, what portion of that establishment's activities should be attributed to recycling/reuse. In the case of product manufacturing, both recycled and non-recycled materials may be used, again raising the question whether the total activity should be included or only a partial amount.

The most challenging issue that recycling economic information studies face is defining the extent of economic information to include when an industry is able to utilize recovered as well as virgin feedstock or makes an intermediate product as well as converts those intermediate products to end-products within the same facility.

Consistent with the methodology developed by NERC on behalf of the EPA, this study includes those activities that are most essential to the continued recycling of materials and reuse of used products. The study boundaries:

- Include all “supply side” activities involved in recovering and preparing materials and used products for resale;
- Include “demand side” activities up to the first point at which the recovered materials or used products have successfully competed directly against their respective primary, or virgin, equivalents;
- Exclude the activities of non-business entities such as individuals, and of advocacy, education and other organizations which do not directly add value to recovered materials and used products, or directly support such activities; and,
- Exclude activities involving incineration or use of materials as fuel.

“Recycling and Reuse” as defined in this study includes the following “covered activities”:

- Collecting materials or used products for the purposes of intermediate processing, manufacturing, and/or distribution by reuse sales establishments;
- Intermediate processing of recovered materials or used products including sorting, cleaning, consolidating, treating, disassembling, densifying, and/or transferring ownership for use in processing, product manufacturing, and/or for distribution by reuse sales establishments;
- Reclaiming of recovered materials or used products to produce refined raw materials and/or reusable products meeting the specifications of manufacturers, reuse sales establishments or other end-users;
- Manufacturing “first-stage” products containing recycled materials or used products;
- Operating wholesale or retail sales establishments that offer, largely or exclusively, used products prepared for reuse; and
- Intimately supporting the above activities through research, equipment development and sales, consulting, engineering, brokering, and exchange services.

The end-point of recycling is considered to be the “first-stage” manufactured product. “First-stage” refers to the first product produced from recycled materials, such as a roll of paper,

sheet of plastic, glass bottle or metal billet. First-stage products are often converted into finished products (e.g., envelopes, plastic bottles, or metal parts), sometimes at the same facility. Only production of first-stage products is intended to be included in this definition. At this stage, the recycled material has successfully competed against virgin material and is often indistinguishable from other first-stage products that are made from those virgin materials. This study attempted to exclude economic activity associated with further conversion within the same facility as these are essentially manufacturing rather than recycling activities.

2.2 BUSINESS CATEGORIES

This report presents recycling and reuse industry data for twenty-six separate business categories. Data is also presented for four categories of support businesses because of their intimate involvement in the industry. The business categories are grouped into three major sectors:

- **Recycling Industry:** includes all collection and processing of recovered materials and manufacturing using recycled materials;
- **Reuse and Remanufacturing Industry:** includes preparation of materials for reuse and remanufacturing of used or broken equipment; and
- **Support Businesses:** businesses that do not directly recycle materials or reuse products, but provide specialized equipment and services necessary to the recycling and reuse industry.

Table 2-1 briefly defines each of the 30 business categories as used in this study. For more detailed definitions, please see Appendix A.

**TABLE 2-1
BUSINESS CATEGORY DEFINITIONS**

Business Category		Definition
Recycling Industry		
1.	Government Staffed Residential Curbside Collection	Recyclables collection using government employees
2.	Private Staffed Residential Curbside Collection	Private sector collection of recyclables, including contract collection on behalf of municipalities
3.	Compost and Miscellaneous Organics Producers	Produce compost, mulch, bark, or bedding from yard and wood waste, biosolids, or other organics, also includes vermiculture
4.	Materials Recovery Facilities	Process commingled or recovered materials, usually from curbside/drop-off collection or recyclables separated from solid waste
5.	Recyclable Material Wholesalers	Paper stock dealers, scrap metal processors, and other establishments that sort, remove contaminants, and densify recovered materials, and brokers of recovered materials
6.	Glass Container Manufacturing Plants	Produce finished glass containers
7.	Glass Product Producers (other recycled uses)	Produce glass products other than containers
8.	Nonferrous Secondary Smelting and Refining Mills	Recycling and alloying of nonferrous metals, primary products include billets, ingots, and other basic shapes
9.	Nonferrous Product Producers	Produce nonferrous products through extrusion, rolling, or drawing processes
10.	Nonferrous Foundries	Produce castings from nonferrous metals

Business Category	Definition
11. Paper, Paperboard, and Deinked Market Pulp Mills	Produce paper and paperboard products from recovered paper or market pulp and/or deink recovered paper and sell pulp
12. Paper-based Product Manufacturers	Produce cellulose-based products from recovered paper or paperboard (e.g., cellulose insulation, hydro-seeding, animal bedding)
13. Pavement Mix Producers (asphalt and aggregate)	Produce asphalt paving mix from recycled materials such as crumb rubber, aggregates, or glass
14. Plastics Reclaimers	Transform recovered plastics directly into products (e.g., plastic lumber) or raw materials ready for remanufacture
15. Plastics Converters	Convert a recycled plastic clean flake or pellet into an intermediate or end product
16. Rubber Product Manufacturers	Manufacture products using crumb rubber or cut rubber shapes and stampings as feedstock
17. Steel Mills	Produce iron and steel slabs, billets, bar, plate, and sheet from scrap and/or raw materials
18. Iron and Steel Foundries	Produce cast iron or steel products
19. Other Recycling Processors/Manufacturers	Other processors and manufacturers not elsewhere classified, using ash, sludge, engineering application of tires or other recovered materials
Reuse and Remanufacturing Industry	
20. Computer and Electronic Appliance Demanufacturers	Sort, grade, dismantle and/or rebuild used electronic appliances
21. Motor Vehicle Parts (used)	Clean, sort, inspect, and remanufacture used automobile parts
22. Retail Used Merchandise Sales	Retail thrift stores, antique shops, reuse centers, and other shops dedicated to selling used merchandise
23. Tire Retreaders	Remove old tread from worn tires and add new tread
24. Wood Reuse	Process used wood for reuse (e.g., pallet rebuilders, construction materials)
25. Materials Exchange Services	Facilitate the reuse of products and materials by commercial and industrial establishments
26. Other Reuse	Other reuse or remanufacturing, not elsewhere classified
Support Businesses	
27. Recycling and Reuse Equipment Manufacturers	Produce new primary equipment designed for use by recycling businesses – conveyers, balers, wash systems, sorting systems
28. Consulting/Engineering	Provide technical research, development, and engineering services to recycling and reuse establishments
29. Transporters	Transport recovered materials or reusable goods by air, rail, water, or truck
30. Other Support Businesses	Other support businesses such as accounting firms, janitorial firms, etc.

2.3 TYPES OF INFORMATION DEVELOPED

The two types of economic information developed in the study were:

- **Direct Economic Information:** Information directly derived from the establishments in each business category and necessary to document industry size; and
- **Total Economic Information:** Information on the economic values that recycling and reuse establishments induce in the greater economy at the state level, including state tax revenue impacts.

In deriving the direct information, five primary data types were developed:

- **Number of Establishments:** An establishment is a single physical location where business is conducted or where services or industrial operations are performed;
- **Employment:** Consists of full and part-time employees, including salaried officers and executives of corporations;
- **Total Annual Payroll:** Includes all forms of compensation, such as salaries, wages, commissions, bonuses, vacation allowances, sick-leave pay, and the value of payments in kind (e.g., free meals and lodgings) paid during the year to all employees;
- **Total Annual Receipts:** Revenue for goods produced, distributed, or services provided, including revenue earned from premiums, commissions and fees, rents, interest, dividends, and royalties. Excludes all revenue collected for local, state, and federal taxes; and
- **Total Throughput:** Total tons of recovered materials collected or processed. This data type was not gathered for reuse and support business categories because reuse businesses typically do not track throughput data in a manner comparable to recycling businesses (e.g., they may use the number of units remanufactured rather than tons).

The total economic information, developed through economic modeling, generated four secondary data types:

- **Indirect Economic Values:** Economic activity accrued by other establishments (suppliers and customers) as a result of the activities of the recycling and reuse businesses;
- **Induced Economic Values:** Economic activity accrued by retail and other establishments because of personal purchases by recycling and reuse industry and indirect establishment employees;
- **Multipliers:** The ratio of total values (direct, indirect, and induced) to direct values; and
- **Tax Revenues:** State revenues derived from taxes, charges and fees, and miscellaneous revenues.

3.1 OVERVIEW

This chapter provides a detailed description of the methodologies used to develop the economic activity estimates shown in Sections 4 and 5. This section includes general descriptions of strategies for data gathering and analysis employed in the study. Notes on the specific methodology for the direct data for each category are shown in Section 4 along with the results of the study.

3.2 APPROACHES TO DIRECT DATA DEVELOPMENT

In developing the direct economic information reported in Section 4, one of three methods was employed for each business category, depending on the availability and adequacy of existing information and business lists:

- **Existing Data:** Obtained through existing sources of information (e.g., U.S. Census Bureau's Economic Census, U.S. Geological Survey's Mineral Commodity Reports, expert opinions by industry and trade associations);
- **Survey Data:** Gathered by surveying the businesses directly and compiling the data into a database of establishments; or
- **Derivation:** Limited existing data was used to derive estimates of economic activity.

The study focused on using existing data, of sufficient quality, and with categories defined consistently with the study, for as many business categories as possible to avoid duplicating efforts if sources of existing information were available. If little or no existing information was available but listings of businesses in a category were available, the next option was to develop a database of businesses and conduct surveys to obtain the desired economic information. When limited existing information was available, but no specific list of establishments could be found for purposes of surveying, estimates were derived based on limited existing data and estimations by industry experts.

Due to the number of different business categories included in this study, the exact methodology used to calculate economic activity for each category was tailored to fit the material flows and processes found in each. Table 3-1 lists the business categories and the approach used for each category.

TABLE 3-1
DATA DEVELOPMENT APPROACH BY CATEGORY

Business Category		Approach
Recycling Industry		
1.	Government Staffed Residential Curbside Collection	Derivation
2.	Private Staffed Residential Curbside Collection	Derivation
3.	Compost and Miscellaneous Organics Producers	Survey
4.	Materials Recovery Facilities	Survey
5.	Recyclable Material Wholesalers	Existing Data
6.	Glass Container Manufacturing Plants	Existing Data
7.	Glass Product Producers (other recycled uses)	Survey
8.	Nonferrous Secondary Smelting and Refining Mills	Existing Data
9.	Nonferrous Product Producers	Existing Data
10.	Nonferrous Foundries	Existing Data
11.	Paper, Paperboard, and Deinked Market Pulp Mills	Existing Data
12.	Paper-Based Product Manufacturers	Survey
13.	Pavement Mix Producers (asphalt and aggregate)	Survey
14.	Plastics Reclaimers	Existing Data
15.	Plastics Converters	Existing Data
16.	Rubber Product Manufacturers	Survey
17.	Steel Mills	Existing Data
18.	Iron and Steel Foundries	Existing Data
19.	Other Recycling Processors/Manufacturers	Survey
Reuse and Remanufacturing Industry		
20.	Computer and Electronic Appliance Demanufacturers	Survey
21.	Motor Vehicle Parts (used)	Existing Data
22.	Retail Used Merchandise Sales	Existing Data
23.	Tire Retreaders	Existing Data
24.	Wood Reuse	Survey
25.	Materials Exchange Services	Survey
26.	Other Reuse	Survey
Support Businesses		
27.	Recycling and Reuse Equipment Manufacturers	Survey
28.	Consulting/Engineering	Modeling
29.	Transporters	Modeling
30.	Other Support Businesses	Modeling

The breakdown of the number of categories served by each approach is:

- Existing Data – 13;
- Survey Data – 12;
- Derivation Data – 2; and
- Modeling – 3.

Each of the three approaches is described in greater detail in the following subsections. Furthermore, Appendix B summarizes data sources used for compiling the survey database or otherwise used for producing direct data for this study.

After the direct economic values were developed, total economic values were estimated through economic modeling using the direct data as inputs. In order to apply the economic model accurately, certain categories required additional information, known as intermediate inputs. To derive the total economic values, the following steps were taken:

- **Survey for Intermediate Inputs** – A detailed survey of a limited number of establishments was conducted to obtain estimates of the amounts of expenditures on inputs such as raw materials, chemicals, electricity, accounting services and other items necessary for production (usually expressed as a dollar amount per \$1,000 in output for a particular type of industry); and
- **Conduct Economic Modeling** – A process based on an input-output approach developed by the U.S. Bureau of Economic Analysis. Several models have been developed, including RIMS II, IMPLAN, and REMI. The model chosen for this study was the IMPLAN.

3.2.1 EXISTING DATA

The first strategy employed was to utilize existing data from public sources or trade associations. The most common example of this strategy was the use of U.S. Census Bureau reports when a category defined in the study aligned well with a distinct census category. Reports from the U.S. Census included the 1997 Economic Census, which provides number of establishments, number of employees, payroll, and receipts for each category of establishment. Recovered material consumption by each category is also reported on the national level in those reports. Other sources of publicly available data included U.S. Geological Survey reports and reports developed by individual state governments.

3.2.1.1 RELATION OF SIC AND NAICS TO BUSINESS CATEGORIES

The U.S. Department of Commerce, Bureau of the Census compiles and reports a wide range of economic data on U.S. industrial activity. Up until 1997, the Census Bureau categorized businesses according to the Standard Industrial Classification (SIC) system developed by the Executive Office of the President, Office of Management and Budget. The system classified establishments by their primary activity. Beginning in 1997, the SIC system is being phased out and will be replaced by the new North American Industrial Classification System (NAICS). The new system harmonizes systems used in Mexico and Canada, in accordance with the North American Free Trade Agreement.

Table A-1, in Appendix A, attempts to classify each business category in the study by SIC and NAICS. The codes were assigned by comparing each business category to the definitions listed in the SIC and NAICS manuals. In many cases, the listed codes also include businesses not involved in recycling and reuse.

3.2.1.2 USE OF U.S. DEPARTMENT OF COMMERCE, BUREAU OF CENSUS STATISTICS

The primary source of U.S. Census data used for this study was the 1997 Economic Census for relevant NAICS codes, which was the most recent data available from the U.S. Census when this study was conducted. Although the Economic Census is only updated every five years, the U.S. Census updates its Standard Statistical Establishments List (SSEL) yearly, which could provide more current data than the Economic Census for future studies.

It should be noted that U.S. Census does not disclose certain data when a NAICS code has a small number of associated businesses and showing exact numbers would reveal sensitive

information for a particular organization. This was not a problem with California because of the state's large size. See Appendix C for a sample of data provided by U.S. Census.

3.2.1.3 ADDITIONAL SOURCES OF EXISTING DATA

Although the most commonly used existing data was the U.S. Census 1997 Economic Census, other sources provided throughput data or partial data for use in derivations or adjustments to original data. These sources of existing information and their contributions include:

- American Forest & Paper Association – State and national throughput data for paper, paperboard, and deinked market pulp mills;
- American Plastics Council – Database provided employment and throughput data for plastics reclaimers;
- Steel Recycling Institute – Expert opinion on the steel recycling process and percentage of activities to include in the study; and
- U.S. Geological Survey – Expert opinions on the recycling of nonferrous metals and the percentage of activities to include in the study for nonferrous product producers and nonferrous foundries.

3.2.2 SURVEY DATA

When little or no existing data was available for a particular business category, but lists of establishments in those categories were available, R.W. Beck conducted surveys of those businesses and performed a statistical analysis of the results to develop estimates of economic activity.

3.2.2.1 RECYCLING ECONOMIC INFORMATION STUDY DATABASE

The National Recycling Coalition as part of the US REI study developed a national database of establishments as a tool for surveying businesses in categories with little or no sources of existing data. The database was compiled from various electronic databases, state directories, periodicals, and other sources.

During the survey process 183 establishments were confirmed to be in survey categories in the state of California. Of the remaining California establishments, as many as 287 are likely to be in survey categories. Although the database contains a number of businesses that are not in survey categories, those listings are incidental incorporations from electronic directories. Please refer to Table 3-1 for a listing of the survey categories for which the database was developed.

3.2.2.2 SURVEY DESIGN

The survey was designed to obtain economic information from businesses in categories with little or no existing information. Appendix D contains a copy of the survey forms that were used for this study.

The survey cover page confirmed the database records for company name, mailing information, physical location, and contact person. For companies with more than one physical location, one cover page and survey for each physical location were completed.

The survey solicited responses to the following questions:

1. Classify the establishment according to the categories defined for the study (respondents could check more than one category);

2. Identify the single category that is most representative of the recycling or reuse-related operations for the establishment;
3. Give estimations of establishment size including number of employees, total annual payroll, and total annual receipts;
4. Estimate the percentages of labor and receipts based on covered recycling activities; and
5. Estimate the amounts, by type, of recycled materials processed.

Checkboxes with associated ranges (i.e., 0-9 employees, \$50,000-\$149,999 total payroll) were used for questions regarding number of employees, payroll, receipts, and percentages. Due to the sensitive nature of the survey questions, it was anticipated that asking for responses in ranges rather than exact numbers would increase the response rate. With enough responses, any variation from the exact amount was likely averaged out.

3.2.2.3 SURVEY APPROACH

Prior to beginning the project it was estimated and budgeted that as many as 1,250 establishments would need to be targeted for survey phone calls. Once the survey database was finalized, 1,081 establishments were listed as being in survey categories or as “unknown.” All of these establishments were mailed a survey. Furthermore, at least three follow-up telephone attempts were made to establishments that failed to respond to the mailed survey in order to obtain survey information.

Once surveys were completed, senior staff reviewed all survey data for accuracy and completeness. Responses were then entered into the REI Study database. After checking the database for errors, the raw data was compiled and analyzed using a statistical approach.

3.2.2.4 SURVEY CALCULATIONS

A statistical analysis of the survey data provided by establishments that completed surveys was used to identify the recycling characteristics of the average establishment in each of the twelve survey business categories. These averages were then applied to all establishments in each survey category to estimate the number of employees¹⁰ involved in recycling activities, as well as the dollar value of recycling and reuse payroll and receipts. However, before making this extrapolation the list of non-responding establishments was examined to identify any establishments that were known to be very large, and whose economic activity would need to be estimated by some other means.

Survey information obtained from 183 firms formed the basis of the statistical analysis. Because many of the establishments initially included in the database were found to have been misclassified or gone out of business, it was necessary to reestimate the number of establishments in each survey category before extrapolating average statistical data. In the California, 470 establishments are believed to be involved in recycling activities in the twelve survey categories. For a detailed explanation of the statistical analysis of surveys, please refer to Appendix E.

3.2.3 DERIVATION DATA

In the third strategy, derivations were made by using data from a variety of sources, such as trade organizations, industry experts, periodicals and other publications. Data points from various sources were pieced together to develop estimates of economic activity. As an

¹⁰ Employee responses were adjusted to a full-time equivalent basis. Thus, two employees each working 50% on recycling activities would be counted as one recycling employee.

example of this approach, a detailed explanation of the sources and methodology used for both public and private curbside collection of recyclables is given in Section 4.2, note 6 of Table 4-2. Additionally, direct data for three of the four support business categories were derived as a result of economic modeling.

3.3 INTERMEDIATE INPUT DATA FOR ECONOMIC MODELING

Prior to beginning economic modeling, the 26 direct recycling and reuse business categories were evaluated to identify those categories where recycling establishments were thought to significantly differ from similar non-recycling establishments in the way they operate, their process inputs, and their purchases from other establishments in the economy. Next, existing in-house data from previous studies was examined to identify where recycling and reuse industry-specific data was lacking.

For those categories lacking adequate input data, a detailed survey that asked for much greater detail regarding the cost elements of production was sent to select establishments. Those establishments that were cooperative and expressed interest in the study during the gathering of the direct economic information (employment, payroll, and revenues) were targeted for the additional surveys. Only a handful of establishments were targeted for each business category because the major process inputs and cost elements of the businesses were assumed to be very similar to each other (and quite different from the cost elements of virgin business establishments).

3.4 ECONOMIC MODELING

This study modeled indirect, induced, and total economic values of 26 categories of recycling or reuse establishments using the IMPLAN¹¹ economic model.

Economic modeling started with the purchase of data files that provided a standard inter-industrial accounting of the California economy. These data files were procured from Minnesota IMPLAN Group, Inc., the data supplier for the IMPLAN model. What followed was an eight-step process to construct a model that would isolate the 26 categories of recycling and reuse establishments from other establishments in the state so that their economic values could be separately analyzed and reported.

The eight-step process is described below:

1. U.S. standard industrial classifications were identified that best corresponded to the kind of recycling product, process, or service that each of the 26 recycling and reuse categories produces. This was necessary because there is no specific set of "recycling and reuse" industries in the 537 industries contained in the data files.
2. These industrial types were controlled for in the initial model while the remaining industries were aggregated to the one-digit SIC level. The initial model that was produced, then, had twenty-six specific recycling industry candidates and twelve broad industrial aggregates (e.g., farming, the remainders of manufacturing, wholesale trade, transportation, etc.).
3. The direct values obtained from the study were substituted for the direct values (also called the "social" accounts) in the model. Estimates of returns to proprietors, property

¹¹ The modeling system used for this study is called IMPLAN Pro, published by the Minnesota IMPLAN Group, Inc. Data are available and may be purchased from this company for all states and all counties in the U.S. Their data standards are rigorous, their data sets are updated annually, and their methods for compiling and processing the main input-output data sets are widely considered to be a significant enhancement of the basic I-O data that are compiled and solicited by the U.S. Bureau of Economic Analysis. This company has the largest user base of any of the commercial input-output models available in the U.S.

income, and indirect tax payments to state and local governments were derived from the averages of the original industrial group. This assumed that the recycling or reuse firms yield roughly the same return on investment to sole proprietors or investors as the corresponding industry that may contain significant non-recycling establishments.

4. The remaining values in the parent category (the original values minus the recycling industry direct values) were then manually placed back into the one-digit industrial sector so that the only direct data in the sector reflected the recycling and reuse industries. This ensured the model's total amount of industrial activity summed to precisely the same value as it had originally, before isolating recycling and reuse business categories.
5. Recycling and reuse establishments differ from non-recycling and reuse establishments in the way they operate, their process inputs, and their purchases from other establishments in the economy. This step attempted to account for these differences with data from two sources: (1) the additional intermediate input data that was collected as described previously; and (2) "in-house" data from other previous county-level studies that were conducted in Iowa, Illinois, Nebraska, and Wisconsin counties that reflected the kinds of recycling industries measured in this study but did not contain virgin-only establishments. Twelve models were built from in-house data from counties to isolate recycling industries (primarily ferrous and nonferrous metals, plastics manufacturing, and paper industries) and their production characteristics. The production inputs in the model were then re-configured so that the industrial linkages to raw commodities, mining, or refiners were reduced and linkages to recycling-related processors were strengthened. These changes resulted in a recalculation of all of the production input values for each recycling and reuse industry category.
6. There are several other components to input-output modeling that were investigated. One modification involved changing regional purchase coefficients (RPCs) in the model. For some materials, recycled commodities may be shipped on average less or greater distances than the virgin alternative, including across state boundaries. In-house data from a previous Recycle Iowa Study (an early economic impact study of recycling) of the general likelihood of a recycled commodity being purchased locally for industrial usage was examined for its bearing on this study. Absent other information about some commodity types, the RPC adjustment for a recycling commodity that was believed to be much more likely purchased locally was estimated by taking the square root of the existing number for that industry. For example, an RPC of 0.31 in a commodity supply category would be inflated to 0.56 to increase the likelihood that the input commodity was purchased locally. RPCs were only changed for a small subset of industries¹² and were only done so to maximize the expected linkage between recovered materials collection, processing, and conversion into final demand goods.

There were other account categories that were assessed also in the input-output model. The byproducts category in the model itemizes the commodity production by industry. Each of these categories was scrutinized and assessed as to its reasonableness for each recycling or reuse industry. No other accounts categories were altered in the models (including exports, institutional demands, or household incomes).

7. The resulting model was then re-checked for errors, omissions, and reasonableness and re-estimated in final form. This step included rebalancing the model so that the gross total equaled the original starting values.
8. Once the final state model was constructed, multipliers were generated for each recycling and reuse industry for Total Industrial Output, Personal Income, Value Added, and Jobs.

¹² RPCs were increased for the following categories: compost and miscellaneous organics producers, plastics reclaimers, motor vehicle parts (used), and wood reuse.

These multipliers were applied to the original direct values to isolate each industry's unique economic contribution.

In order to estimate state revenues associated with the economic data (direct as well as indirect and induced), data on California's government finances were gathered for 1992 through 1997 from the U.S. Census of Governments publications. Data on incomes were obtained from the U.S. Bureau of Economic Analysis Regional Economic Information System. Annual incomes were converted to fiscal values, and the weighted average revenue incidences for state government own-source revenues¹³ was compiled for:

- All State Taxes (e.g., personal, corporate, sales, use, excise, etc.);
- Charges and Fees (e.g., direct state charges and fees, including higher education and health);
- Miscellaneous Revenues (e.g., special revenues, gifts, interest earnings, etc.); and
- Total Own-Source Revenues (i.e., the sum of the previous three items).

The revenue indices that were developed were then applied to the direct and total values of industrial output and personal income to yield state revenue estimates.

3.5 VALIDATION OF STUDY RESULTS

Upon completion of the REI study, various methods of internal and external review were used to ensure that both direct and indirect study results were valid and meaningful. The methods of internal review included:

- Review of completed surveys by senior staff; and
- Comparisons of per-establishment and per-employee figures from California to similar figures from other state/regional REI studies.

External review included a review of the direct economic information for the 26 recycling and reuse categories by the CIWMB. Furthermore, previous reviews by state government staff and industry trade associations of the Northeast data produced by the NERC REI Study and the other state studies validated that the study methodology fairly and conservatively characterized the level of economic activity for their state or industry.¹⁴

¹³ "Own-source" means collected through the state revenue system and not received, for example, as a state disbursement of funds collected through the federal revenue system.

¹⁴ Trade associations that reviewed the NERC study included the American Forest & Paper Association, the American Plastics Council, the Institute of Scrap Recycling Industries, and the Steel Recycling Institute.

This section presents the detailed results and explanations of estimates for individual data points. The section contains:

- A general description of the format for the California Recycling and Reuse Industry data table;
- The California Recycling and Reuse Industry data table of results, including numbered notes that correspond to specific data points in the table and explain how the data was derived;
- An analysis of the results; and
- A discussion of the accuracy and completeness of the results.

4.1 GENERAL NOTES ON DATA TABLES

This section provides general information regarding the format of the California Recycling and Reuse Industry data table presented in this section. Detailed descriptions of all table column headings and an explanation of the three tiers of data presented are given here.

4.1.1 THREE-TIERED APPROACH TO DATA PRESENTATION

Three facts about recycling and reuse businesses complicate recycling economic information studies and have led to inconsistency in past efforts:

- Most establishments involved in recycling and reuse are part of industries in which many establishments do not recycle or reuse recovered materials or products at all;
- Some establishments involved in recycling or reuse are also involved in non-recycling activities not intended to be covered in this study; and
- Many recycling manufacturers use less than 100 percent recycled feedstock and/or adjust the percentage of recycled feedstock throughout the year.

Past studies have handled each of these challenges differently. In an effort to exclude non-recycling activities, some studies relied on survey respondents to estimate recycling activities. Other studies have targeted all facilities involved in recycling and did not attempt to adjust the statistics to account for non-recycling activities. Various industry and recycling experts have criticized both approaches.

To overcome these challenges, the California REI Study is reporting three tiers of statistics. The goals of this approach are:

- To report statistics on recycling and reuse-related businesses as they actually exist in the economy (i.e., as part of industries and establishments that do not always involve recycling); and
- To derive conservative estimates for the amount of economic activity that can "reasonably" be attributed exclusively to recycling. The three tiers of statistics are described below.

4.1.1.1 TIER ONE - STATISTICS ON ALL INDUSTRY ESTABLISHMENTS

Tier One statistics are reported only for certain business categories where data was available from a source that included all establishments in the category, even though some of them may

not do any recycling. This information typically comes from U.S. Bureau of Census data by NAICS code. For example, data for all paper mills will be shown even though some of those establishments do not utilize recovered paper.

4.1.1.2 TIER TWO - STATISTICS ON ESTABLISHMENTS INVOLVED IN RECYCLING

Like Tier One, Tier Two statistics are only reported for certain business categories where data was available from a source that aggregated data for recycling and non-recycling establishments. The data covers only those establishments that have some involvement in recycling, and attempts to exclude data on establishments with no recycling activities. Although all of these establishments perform some amount of recycling or reuse activity, they may also perform non-recycling activities not covered in this report. For example, information on all paper mills that utilize recovered paper would be included here, even though some of these establishments may also be involved in non-covered activities like production of wood pulp.

4.1.1.3 TIER THREE - STATISTICS ON COVERED RECYCLING ACTIVITIES

Tier Three statistics are the heart of this study and are reported for all business categories. They are conservative estimates of the portion of economic activity in Tier One or Tier Two that can be reasonably attributed to the recycling activities covered in the study. Most Tier Three estimates are derived from survey results in which respondents themselves are asked to identify what percentage of their facility's activities involves "covered activities."¹⁵ For some important categories, including paper, plastics and metals manufacturers, an algorithm is being used to estimate covered economic activity. The algorithms begin with Tier One and Tier Two data as described above. Then, the percentage of Tier Two activity involving covered recycling activities is being estimated based on available statistics and industry expert opinions. The exact approach used for each category is documented in detail in Section 4.2. Additionally, Tier Three statistics are reported in two columns, depending on whether the establishments in the category are "100 percent dependent on recycling," or simply "undertaking recycling activities." Those establishments that are dependent on recycling have 100 percent of employment and revenues derived from recycling activities, while those that are "undertaking recycling activities" have only a portion of economic activity derived from recycling. This distinction is intended to assist in accurately and conservatively reporting overall results and to further illuminate the actual structure of the recycling industry.

4.1.2 DEFINITIONS OF COLUMN HEADINGS IN THE DATA TABLES

For Table 4-2, the lettered column headings are defined as follows:

- A. Business Category – for a detailed list of business category definitions, refer to Appendix A.
- B. Data Type – the data types presented in Table 4-2 are:
 - Establishments – an establishment is a single physical location of a company or government. A single company or government may have multiple establishments (physical locations).
 - Employment – total number of employees for all establishments in a category.
 - Annual Payroll – total annual payroll for all employees in a category; reported in thousands of dollars.

¹⁵ For a complete definition of covered activities, refer to Section 2.1 and note 2 on page 4-7.

- Estimated Receipts – total annual estimated receipts for all establishments in a category; reported in thousands of dollars.
 - Estimated Throughput – if possible, total tons of materials processed is estimated; reported in thousands of tons.¹⁶
- C. Total Statistics on all Industry Establishments – the combined statistics for all establishments in categories without regard to recycling activity.¹⁷
- D. Total Statistics on Establishments Undertaking Some Recycling or Reuse Activities – a subset of Column C and reports statistics on only those establishments with some portion of operations in covered recycling activities. Establishments in this column may have all of their operations or only a portion of their operations involved in covered recycling activities. This column excludes any virgin-only establishments that may be shown in Column C.
- E. Statistics on Establishments Undertaking Recycling or Reuse Activities – a subset of Column D and focuses on the employment, payroll, and receipts figures in establishments with less than 100 percent of operations involved in recycling or reuse-related activities. The same establishments are considered in columns D and E. The employment, payroll, and receipts figures are adjusted to eliminate employees who are focused on virgin material preparation, and further discounted for other non-covered activities.
- F. Statistics on Establishments 100% Recycling or Reuse-Dependent – estimates for establishments with 100 percent of operations dependent on recycling or reuse, which in most cases establishments consume no virgin material.¹⁸ This column presents data that is discounted for non-covered activities.
- G. Estimates of Total Recycling-Related Economic Activity – conservative estimates of total recycling or reuse-related economic activity. These estimates were developed by adding Columns E and F.

4.1.3 ABBREVIATIONS USED IN DATA TABLES

Table 4-1 presents a list of abbreviations used in the data table.

TABLE 4-1
ABBREVIATIONS USED IN TABLE OF RESULTS

Abbreviation	Definition
AF&PA	American Forest & Paper Association
AISE	American Iron and Steel Engineers
APC	American Plastics Council
GPI	Glass Packaging Institute
REI	Recycling Economic Information Study
SPI	Society of the Plastics Industry
SRI	Steel Recycling Institute
USGS	U.S. Geological Survey

¹⁶ Note that subtotals and grand totals for throughput are not shown due to the potential for triple-counting material by adding tons of the same material at three different stages - collection, local processing, and reclamation/manufacturing.

¹⁷ A category may not show data for Column C because: (1) it does not have virgin-only establishments; or (2) virgin-only establishments were excluded from the data collection process.

¹⁸ All domestic steel mills depend on a minimum level of scrap in their processes. Therefore, all steel mill economic activity is included in this column even though some mills use virgin feedstock.

4.2 DATA TABLE

TABLE 4-2
CALIFORNIA RECYCLING AND REUSE INDUSTRY ECONOMIC INFORMATION

ANNUAL PAYROLL AND ESTIMATED RECEIPTS ARE IN \$1,000. THROUGHPUT IS IN THOUSANDS OF TONS. ALL NUMBERED NOTES ARE FULLY EXPLAINED AT THE END OF THE DATA TABLE.

		Tier 1		Tier 2		Tier 3					
		C. Total Statistics on All Industry Establishments (not all perform recycling or reuse-related activities) [1]		D. Total Statistics on Establishments Undertaking Some Recycling or Reuse Activities (includes recycling and non-recycling activities) [2], [3]		E. Statistics on Establishments Undertaking Recycling or Reuse Activities (excluding virgin material preparation and downstream conversion activities) [2],[4]		F. Statistics on Establishments 100% Recycling or Reuse-Dependent (No virgin material) [2],[5]		G. Estimates of Total Recycling-Related Economic Activity(Sum of columns E and F)	
A. Business Category	B. Data Type	Estimates	Sources	Estimates	Sources	Estimates	Sources	Estimates	Sources		
Recycling Industry Economic Activity											
1. Government Staffed Collection	Establishments							198	Derivation: multiple sources [6]	198	
	Employment							1,900		1,900	
	Annual Payroll							65,740		65,740	
	Estimated Receipts							130,722		130,722	
	Estimated Throughput							5,269	Derivation: multiple sources [7]	5,269	
2. Private Staffed Collection	Establishments							323	Derivation: multiple sources [8]	323	
	Employment							3,100		3,100	
	Annual Payroll							107,260		107,260	
	Estimated Receipts							213,283		213,283	
	Estimated Throughput							34,381	Derivation: multiple sources [9]	34,381	
3. Compost and Miscellaneous Organics Producers	Establishments							162	REI Study Database [10]	162	
	Employment							1,892	Results extrapolated based on	1,892	
	Annual Payroll							46,119	California survey statistical mean	46,119	
	Estimated Receipts							304,722	(n=71). [11], [12]	304,722	
	Estimated Throughput							9,208		9,208	
4. Materials Recovery Facilities (MRFs)	Establishments							47	REI Study Database [10]	47	
	Employment							2,606	Results extrapolated based on	2,606	
	Annual Payroll							49,986	California survey statistical mean	49,986	
	Estimated Receipts							206,424	(n=13). [11]	206,424	
	Estimated Throughput							3,625		3,625	
5. Recyclable Material Wholesalers	Establishments							1,000	U.S. Census, 1997 Econ. Census	1,000	
	Employment							13,710	NAICS code 421930. [13], [14]	13,710	
	Annual Payroll							344,894		344,894	
	Estimated Receipts							4,549,177		4,549,177	
	Estimated Throughput							26,817	Derivation [15]	26,817	
6. Glass Container Manufacturing Plants	Establishments			8	U.S. Census, 1997 Econ. Census	8	From Column D [17]			8	
	Employment			3,348	NAICS code 327213. [13]	3,013	Column D adjusted for			3,013	
	Annual Payroll			136,544		122,890	non-covered activities. [17]			122,890	
	Estimated Receipts			724,192		651,773				651,773	
	Estimated Throughput			644	1996 CIWMB Data [16]	644	From Column D [17]			644	
7. Glass Product Producers (other recycled uses)	Establishments					9	REI Study Database [10]			9	
	Employment					697	Results extrapolated based on			697	
	Annual Payroll					8,233	California survey statistical mean			8,233	
	Estimated Receipts					52,749	(n=5). [11]			52,749	
	Estimated Throughput					100	Survey & 1996 CIWMB data [18]			100	
8. Nonferrous Secondary Smelting and Refining Mills	Establishments			43	U.S. Census, 1997 Econ. Census			43	From Column D [20]	43	
	Employment			1,681	NAICS codes 331314, 331423, and 331492. [13]			1,597	Column D adjusted for	1,597	
	Annual Payroll			65,794				62,504	non-covered activities [20]	62,504	
	Estimated Receipts			744,916				707,670		707,670	
	Estimated Throughput			281	1997 Economic Census [19]			281	From Column D [20]	281	
9. Nonferrous Product Producers	Establishments	36	U.S. Census, 1997 Econ. Census	18	Column C adjusted for	18	From Column D [17]			18	
	Employment	3,260	NAICS codes 331315, 331316, 331319, and 331421. [13]	1,630	establishments that don't recycle	1,467	Column D adjusted for			1,467	
	Annual Payroll	104,441		52,221	[21]	46,998	non-covered activities [17]			46,998	
	Estimated Receipts	732,247		366,124		329,511				329,511	
	Estimated Throughput			107	1997 Economic Census [22]	107	From Column D [17]			107	

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		Tier 1		Tier 2		Tier 3				
		C. Total Statistics on All Industry Establishments (not all perform recycling or reuse-related activities) [1]		D. Total Statistics on Establishments Undertaking Some Recycling or Reuse Activities (includes recycling and non-recycling activities) [2], [3]		E. Statistics on Establishments Undertaking Recycling or Reuse Activities (excluding virgin material preparation and downstream conversion activities) [2],[4]		F. Statistics on Establishments 100% Recycling or Reuse-Dependent (No virgin material) [2],[5]		G. Estimates of Total Recycling-Related Economic Activity (Sum of columns E and F)
A. Business Category	B. Data Type	Estimates	Sources	Estimates	Sources	Estimates	Sources	Estimates	Sources	
10. Nonferrous Foundries	Establishments			166	U.S. Census. 1997 Econ. Census	166	From Column D [17]			166
	Employment			5,056	NAICS codes 331521, 331524,	4,550	Column D adjusted for			4,550
	Annual Payroll			148,607	331525, 331528. [13]	133,746	non-covered activities [17]			133,746
	Estimated Receipts			482,401		434,161				434,161
	Estimated Throughput			33	1997 Economic Census [23]	33	From Column D [17]			33
11. Paper, Paperboard, and Deinked Market Pulp Mills	Establishments	25	U.S. Census, 1997 Econ. Census	24	Derived from Column C with data	4	Derived from Column D with data	20	Derived from Column D with data	24
	Employment	3,893	NAICS code 3221. [13]	3,153	from AF&PA and Lockwood Post	155	from AF&PA and Lockwood Post	2,786	from AF&PA and Lockwood Post	2,940
	Annual Payroll	198,209		160,549	[24]	7,867	with an adjustment for non-	141,845	with an adjustment for non-	149,712
	Estimated Receipts	1,472,635		1,192,834		58,449	covered activities. [25]	1,053,869	covered activities [25]	1,112,318
	Estimated Throughput			2,369		116		2,203		2,319
12. Paper-Based Product Manufacturers	Establishments							16	REI Study Database[10]	16
	Employment							520	Results extrapolated based on	520
	Annual Payroll							15,713	California survey statistical mean	15,713
	Estimated Receipts							104,528	(n=8). [11]	104,528
	Estimated Throughput							196		196
13. Pavement Mix Producers (asphalt and aggregate)	Establishments					15	REI Study Database[10]			15
	Employment					228	Results extrapolated based on			228
	Annual Payroll					2,990	California survey statistical mean			2,990
	Estimated Receipts					41,370	(n=11). [11]			41,370
	Estimated Throughput					2,128				2,128
14. Plastics Reclaimers	Establishments							63	APC Database [26]	63
	Employment							1,499		1,499
	Annual Payroll							43,090	Derivation -'97 Econ. Census [26]	43,090
	Estimated Receipts							126,276	Derivation - Plastics News [26]	126,276
	Estimated Throughput							234	APC Database [26]	234
15. Plastics Converters	Establishments	1,895	SPI Economic Report 2000 for	309	Derivation: from SPI data [28]	309	From Column D [30]			309
	Employment	127,000	NAICS codes 325991 and 3261	20,683	Derivation; from SPI data [28]	16,546	Column D adjusted for			16,546
	Annual Payroll	3,862,900	plus captive plastics converting	629,101	Derivation; from SPI data [28]	503,281	non-covered activities [30]			503,281
	Estimated Receipts	19,008,200	[27]	3,095,621	Derivation; from SPI data [28]	2,476,497				2,476,497
	Estimated Throughput			229	APC Database [29]	229	From Column D [30]			229
16. Rubber Product Manufacturers	Establishments					15	REI Study Database[10]			15
	Employment					271	Results extrapolated based on			271
	Annual Payroll					9,363	California survey statistical mean			9,363
	Estimated Receipts					56,880	(n=2). [11]			56,880
	Estimated Throughput					19				19
17. Steel mills	Establishments			1	Association of Iron and Steel			1	From Column D [33]	1
	Employment			350	Engineers [31]			333	Column D adjusted for	333
	Annual Payroll			18,227	Derivation [32]			17,316	non-covered activities [33]	17,316
	Estimated Receipts			135,828				129,036		129,036
	Estimated Throughput			675	Assn. of Iron and Steel Eng. [31]			675	From Column D [33]	675
18. Iron and Steel Foundries	Establishments			77	U.S. Census. 1997 Econ. Census	77	From Column D [36]			77
	Employment			5,175	NAICS code 33151. [13], [34]	4,916	Column D adjusted for non-			4,916
	Annual Payroll			149,345		141,878	covered activities D [36]			141,878
	Estimated Receipts			612,882		582,238				582,238
	Estimated Throughput			447	1997 Economic Census [35]	447	From Column D [36]			447
19. Other Recycling Processors/Manufacturers	Establishments					31	REI Study Database[10]			31
	Employment					871	Results extrapolated based on			871
	Annual Payroll					20,854	California survey statistical mean			20,854
	Estimated Receipts					84,661	(n=13). [11]			84,661
	Estimated Throughput					1,177				1,177
Recycling Industry Subtotals	Establishments					652		1,873		2,525
	Employment					32,715		29,942		62,657
	Annual Payroll					998,100		894,468		1,892,568
	Estimated Receipts					4,768,289		7,525,708		12,293,996

SECTION 4

		Tier 1		Tier 2		Tier 3				
		C. Total Statistics on All Industry Establishments (not all perform recycling or reuse-related activities) [1]		D. Total Statistics on Establishments Undertaking Some Recycling or Reuse Activities (includes recycling and non-recycling activities) [2], [3]		E. Statistics on Establishments Undertaking Recycling or Reuse Activities (excluding virgin material preparation and downstream conversion activities) [2],[4]		F. Statistics on Establishments 100% Recycling or Reuse-Dependent (No virgin material) [2],[5]		G. Estimates of Total Recycling-Related Economic Activity (Sum of columns E and F)
A. Business Category	B. Data Type	Estimates	Sources	Estimates	Sources	Estimates	Sources	Estimates	Sources	
Reuse and Remanufacturing Industry Economic Activity										
20. Computer and Electronic Appliance Demanufacturers	Establishments					34	REI Study Database [10]			34
	Employment					956	Results extrapolated based on			956
	Annual Payroll					24,696	California survey statistical mean			24,696
	Estimated Receipts					125,120	(n=13). [11]			125,120
	Estimated Throughput					N/A				N/A
21. Motor Vehicle Parts (used)	Establishments							773	U.S. Census, 1997 Econ. Census	773
	Employment							5,288	NAICS code 421140; [15], [37]	5,288
	Annual Payroll							108,208		108,208
	Estimated Receipts							653,927		653,927
	Estimated Throughput							N/A		N/A
22. Retail Used Merchandise Sales	Establishments							1,895	U.S. Census, 1997 Econ. Census	1,895
	Employment							13,845	NAICS code 453310; [15], [38]	13,845
	Annual Payroll							185,931		185,931
	Estimated Receipts							877,939		877,939
	Estimated Throughput							N/A		N/A
23. Tire Retreaders	Establishments							68	U.S. Census, 1997 Econ. Census	68
	Employment							893	NAICS code 326212; [15], [39]	893
	Annual Payroll							20,971		20,971
	Estimated Receipts							111,147		111,147
	Estimated Throughput							N/A		N/A
24. Wood Reuse	Establishments					32	REI Study Database [10]			32
	Employment					375	Results extrapolated based on			375
	Annual Payroll					4,503	California survey statistical mean			4,503
	Estimated Receipts					29,088	(n=12). [11]			29,088
	Estimated Throughput					N/A				N/A
25. Materials Exchange Services	Establishments							4	REI Study Database [10]	4
	Employment							19	Results extrapolated based on	19
	Annual Payroll							728	California survey statistical mean	728
	Estimated Receipts							7,456	(n=2). [11]	7,456
	Estimated Throughput							N/A		N/A
26. Other Reuse	Establishments					11	REI Study Database [10]			11
	Employment					212	Results extrapolated based on			212
	Annual Payroll					12,315	California survey statistical mean			12,315
	Estimated Receipts					83,501	n=(7). [11]			83,501
	Estimated Throughput					N/A				N/A
Reuse Industry Subtotals	Establishments					77		2,740		2,817
	Employment					1,543		20,045		21,588
	Annual Payroll					41,514		315,838		357,352
	Estimated Receipts					237,709		1,650,469		1,888,178
GRAND TOTALS Recycling and Reuse/Remanufacturing						729		4,613		5,342
	Establishments					34,258		49,987		84,245
	Employment					1,039,614		1,210,306		2,249,919
	Annual Payroll					5,005,998		9,176,177		14,182,174
	Estimated Receipts									

1 Statistics for Column C include data for all establishments in industries with recycling or reuse-related activities. Although the industry overall performs recycling or reuse-related activities, it may include some establishments with no recycling or reuse-related activities.

2 Covered activities is defined as all activities that support:

- Transforming pre-consumer materials or post-consumer products into a recycled material;
- Transforming recycled materials into a first intermediate product (e.g., sheet, fiber, roll);
- Transforming recycled materials directly into a finished product;
- Preparing used products for reuse; and
- Manufacturing equipment for the recycling or reuse industries.

Covered activities *do not* include converting a first intermediate product to finished or semi-finished products or preparing materials for fuel use.

3 Statistics are for establishments with some amount of covered recycling activities. Establishments may perform both non-recycling and recycling activities.

4 These estimates include activities where virgin and recycled feedstock materials are co-processed. The estimates do not include virgin-only feedstock material preparation activities and further conversion of intermediate products to finished or semi-finished goods.

5 Statistics on establishments where 100 percent of labor and receipts are dependent on recycling or reuse-related activities. The estimates do not include virgin-only feedstock material preparation activities and further conversion of intermediate products to finished or semi-finished goods.

6 The data for Category 1, Government Staffed Residential Curbside Collection, was derived through an algorithm based on data points from a variety of sources. The following tables summarize calculations and data sources used in making estimates of economic activity for this category.

Summary of Calculations

Data Type	Calculation ¹
Establishments	1) $K \cdot D$
Recycling Collection Employees	2) $((A/(B \cdot C \cdot F)) \cdot D \cdot E) \cdot (1+G) \cdot (1+H)$
Yard Waste Collection Employees	3) $((A/(B \cdot L \cdot F)) \cdot D \cdot M \cdot N \cdot O) \cdot (1+G) \cdot (1+H)$
Total Curbside Recycling and Yard Waste Collection Employees	4) Calculation 2+ Calculation 3
Annual Payroll	5) Calculation 4 * I
Receipts	6) $(A/B) \cdot D \cdot (J+N \cdot P) \cdot 12 \text{ months/year}$

¹Variables are defined in the following table.

Endnotes continued on the next page.

SECTION 4

SUMMARY OF DATA SOURCES USED FOR GOVERNMENT STAFFED RESIDENTIAL CURBSIDE COLLECTION

Data Label	Data Type	Value	Reference
A	Population with curbside collection	19,100,000	BioCycle (11/2000)
B	Persons per household	2.79	U.S. Census Bureau
C	Homes collected per truck per day	900	R. W. Beck Estimate
D	Percent of homes collected by government staffed collection	38%	R. W. Beck Privatization Study
E	Average crew per truck	1.5	R. W. Beck Estimate
F	Collection days per cycle	5	Assumes once per week collection
G	Additional percent supervisory	10%	R. W. Beck Estimate
H	Additional percent absenteeism, etc.	5%	R. W. Beck Estimate
I	Average payroll per employee	\$34,600	1997 U.S. Economic Census
J	Recycling collection cost per household per month	\$2.50	R. W. Beck Estimate
K	Number of curbside programs	521	BioCycle (11/2000)
Additional Data for Yard Waste Collection			
L	Homes collected per truck per day	1,000	R. W. Beck Estimate
M	Average crew per truck	2	R. W. Beck Estimate
N	Percent of households with yard waste collection	75%	Estimated from BioCycle (11/2000)
O	Percent of year collection takes place	100%	R. W. Beck Estimate
P	Yard Waste Collection Cost per Household per Month	\$2.25	R. W. Beck Estimate

7 Due to the unavailability of California data throughput is estimated based on per-employee collection averages for recyclables from Florida plus an estimate for yard waste from California Compost and Miscellaneous Organics Products Producers.

8 Calculations and values for Private Staffed Residential Curbside Collection are the same as those presented in Note 6, with the exception of Data Label D. For Category 2, Data Label D is "Percent of Homes Collected by Private Sector."

9 Throughput is derived by subtracting the Government Staffed Curbside Collection tonnage estimate from the sum of processing estimates for Compost and Organics Producers, Materials Recovery Facilities, and Recyclable Material Wholesalers.

10 Number of establishments for all survey categories is based on the REI study database.

Endnotes continued on the next page.

- 11 Unless noted otherwise, number of employees, payroll, receipts, and throughput for all survey categories is based on a statistical analysis of California survey results. See Section 3.2.2 for a detailed description of survey design and calculations. The number of completed surveys on which results are based is given as "n."
- 12 Surveys focused on active processing of organic materials for beneficial use. As a result, number of establishments, potential economic activity, and throughput associated with inactive composting techniques (i.e., allowing materials to slowly and independently decompose over time) may not be fully reflected in totals.
- 13 Data obtained from the U.S. Census, 1997 Economic Census. See Section 3.2.1.2 for a detailed description of the use of Census Bureau statistics.
- 14 Data are taken directly from U.S. Census, 1997 Economic Census for NAICS code 421930 – Recyclable Material Wholesalers. This category includes a number of different types of businesses including scrap metal and plastics dealers, C&D processors, beneficiation facilities, crumb rubber producers and textile processors. No adjustments were made to Census data since the category is defined as 100 percent recycling-related.
- 15 Throughput for Recyclable Material Wholesalers is derived as follows:
ferrous scrap processor revenue/\$128 per ton + paper processor revenue/\$126 per ton + other wholesalers/\$300 per ton.
- 16 Data for 1996 taken from the California Integrated Waste Management Board's *Glass Marketing Guide*, June 11, 1998.
- 17 Number of establishments and throughput are taken from Column D with no adjustments. Employment, annual payroll, and estimated receipts are derived from Column D with an adjustment for the percent of covered activities (90 percent).
- 18 Throughput is derived from a combination of survey results and 1996 fiberglass plant consumption from the California Integrated Waste Management Board's *Glass Marketing Guide*, June 11, 1998.
- 19 Throughput for nonferrous smelting and refining is estimated based on national scrap consumption for smelting and refining mills from the 1997 Economic Census and information from the USGS' publication *Minerals Information – 1997, Recycling – Metals*. Allocation to the state level is based on a ratio of state employment to national employment for this industry.
- 20 Employment, payroll, and receipts are derived from Column D with an adjustment for the percent of covered activities (95 percent). Number of establishments and throughput are from Column D with no adjustment.
- 21 Data are derived by multiplying Column C figures by 50 percent, the percentage of establishments assumed to be utilizing scrap or recycled materials, based on comments from U.S.G.S. nonferrous metals specialists.
- 22 Throughput for Nonferrous Product Producers is estimated based on nationwide scrap purchases for this industry as reported in the 1997 Economic Census. Allocation to the state level is based on a ratio of state employment to national employment for this industry.
- 23 Throughput for Nonferrous Foundries is estimated based on scrap purchases reported in the 1997 Economic Census. Total tons of scrap for the U.S. is calculated as:
Total Scrap Cost (by NAICS code) / (\$0.45/lb for aluminum or \$0.72/lb. for copper) / (2,000 lbs/ton).
Tons of scrap on a state-level is estimated as:
Total tons x State Employees/U.S. Employees.
- 24 Estimates of establishments, employees, payroll, receipts, and throughput are derived from Column C based on information on mills that consume recovered paper from AF&PA's *Paper Matcher* and mill capacity data from Lockwood Post's *Directory of the Pulp, Paper, and Allied Trades*. Throughput is taken from the AF&PA *Annual Statistical Summary Recovered Paper Utilization* (April, 1999). Throughput numbers used are for 1997 to coincide with the data from the 1997 Economic Census.
- 25 Estimates of employees, payroll, and receipts are derived from Column D with an adjustment for the percent of covered activities (95 percent). The split between Columns E and F comes from mill capacity data from Lockwood Post's *Directory of the Pulp, Paper, and Allied Trades* and AF&PA's *Paper Matcher* which provided information on types of recovered paper consumed by individual mills.
- 26 For Plastics Reclaimers, establishments, employees, and throughput are based on the American Plastics Council Handler & Reclaimer database developed by R.W. Beck. Payroll is calculated by multiplying employment figures by Census Bureau's 1997 average wage for California plastics industry employees (\$28,746). Estimated receipts is calculated by multiplying throughput of recycled resins produced times an average of recycled resin prices from Plastics News. Throughput is derived from per-employee averages from American Plastics Council statistics as compiled by R. W. Beck.

Endnotes continued on the next page.

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- 27** Establishments, employees, payroll, and receipts in Column C for Plastics Converters are obtained from the Society of the Plastics Industry's *Economic Report 2000* for plastics converters (NAICS codes 325991 and 3261) plus additional estimates for captive plastics converting operations by establishments classified in other non-plastics industries.
- 28** Number of establishments, employees, payroll, and estimated receipts in Column D are derived by multiplying Column C figures by the industry-wide recycled-content percentage (5.7 percent) divided by the average recycled content of products that contain recycled materials (35 percent).
- 29** Throughput is calculated from the state's percentage of national plastics converter employees multiplied by the total tons of plastics recycled nationally (APC Plastics Recycling Rate Study as compiled by R. W. Beck, with additions for pre-consumer plastics recycled).
- 30** Number of establishments and throughput are directly from Column D. Employees, payroll, and receipts are derived from Column D by multiplying by the estimated percent of employees at recycling-related establishments that are involved in covered recycling-related activities (80 percent).
- 31** Establishments, employees, and throughput data are derived from Association of Iron and Steel Engineers directory listings that exclude non-integrated mills (NAICS 3311114), which do not make steel.
- 32** Employment and payroll data are derived from national averages allocated on a per-employee basis.
- 33** Employment, payroll, and receipts are equal to estimates from Column D multiplied by 95 percent (5 percent deduction to account for downstream conversion). Based on comments from SRI, 100 percent of steel mills are dependent on recovered steel to make new steel, utilizing anywhere from 15 percent-100 percent recovered steel. Therefore, the only deduction taken is to account for non-covered activities. Establishments and throughput are from Column D with no adjustment.
- 34** For Iron and Steel Foundries, estimates for Column D are taken directly from U.S. Census SSEL with no adjustments. SRI states that all foundries as a matter of practice utilize a significant percentage of scrap in the making of new iron products.
- 35** Throughput for Iron and Steel Foundries is estimated as the state's percentage of total national foundry employees multiplied by national scrap consumption by foundries (1997 Economic Census).
- 36** In Column E, establishments and throughput are taken directly from Column D. Employees, payroll, and receipts from Column D are multiplied by 95 percent, the estimated percent of foundry employees involved in covered recycling-related activities.
- 37** The 1997 Economic Census only reported number of establishments for Motor Vehicle Parts to avoid disclosing individual company information. Estimates for employment, payroll, and receipts are derived from California per-establishment average data from the U.S. Census' 1996 Standard Statistical Establishments List for SIC code 5015 (Motor Vehicle Parts) times the number of establishments from the 1997 Economic Census for NAICS code 421140.
- 38** Estimates for Retail Used Merchandise Sales are taken directly from the 1997 Economic Census for NAICS code 453310 with no adjustments.
- 39** Estimates for Tire Retreaders are taken directly from the 1997 Economic Census for NAICS code 326212 with no adjustments.

4.3 ANALYSIS OF RESULTS

Table 4-3 presents an analysis of three data types related to the results presented in Table 4-2. The three analyses performed for each category and sector (recycling and reuse) were:

- The number of establishments, employees, payroll, and receipts as a percentage of the total for all categories;
- Number of employees per establishment; and,
- Average annual payroll per employee.

TABLE 4-3
ANALYSIS OF ECONOMIC ACTIVITY FOR THE RECYCLING AND REUSE INDUSTRY

ANNUAL PAYROLL AND ESTIMATED RECEIPTS ARE IN \$1,000. THROUGHPUT IS IN THOUSANDS OF TONS.

Business Category	Data Type	Estimates of Recycling and Reuse Activity	Percent of Total for All Categories	Employees per Establishment	Annual Payroll per Employee	Estimated Receipts per Employee
Recycling Industry Economic Activity						
1. Government Staffed Residential Curbside Collection	Establishments	198	3.7%			
	Employment	1,900	2.3%	10		
	Annual Payroll	65,740	2.9%		35	
	Estimated Receipts	130,722	0.9%			69
2. Private Staffed Residential Curbside Collection	Establishments	323	6.0%			
	Employment	3,100	3.7%	10		
	Annual Payroll	107,260	4.8%		35	
	Estimated Receipts	213,283	1.5%			69
3. Compost and Miscellaneous Organics Producers	Establishments	162	3.0%			
	Employment	1,892	2.2%	12		
	Annual Payroll	46,119	2.0%		24	
	Estimated Receipts	304,722	2.1%			161
4. Materials Recovery Facilities (MRF's)	Establishments	47	0.9%			
	Employment	2,606	3.1%	55		
	Annual Payroll	49,986	2.2%		19	
	Estimated Receipts	206,424	1.5%			79
5. Recyclable Material Wholesalers	Establishments	1,000	18.7%			
	Employment	13,710	16.3%	14		
	Annual Payroll	344,894	15.3%		25	
	Estimated Receipts	4,549,177	32.1%			332
6. Glass Container Manufacturing Plants	Establishments	8	0.1%			
	Employment	3,013	3.6%	377		
	Annual Payroll	122,890	5.5%		41	
	Estimated Receipts	651,773	4.6%			216
7. Glass Product Producers (other recycled uses)	Establishments	9	0.2%			
	Employment	697	0.8%	77		
	Annual Payroll	8,233	0.4%		12	
	Estimated Receipts	52,749	0.4%			76
8. Nonferrous Secondary Smelting and Refining Mills	Establishments	43	0.8%			
	Employment	1,597	1.9%	37		
	Annual Payroll	62,504	2.8%		39	
	Estimated Receipts	707,670	5.0%			443
9. Nonferrous Product Producers	Establishments	18	0.3%			
	Employment	1,467	1.7%	82		
	Annual Payroll	46,998	2.1%		32	
	Estimated Receipts	329,511	2.3%			225
10. Nonferrous Foundries	Establishments	166	3.1%			
	Employment	4,550	5.4%	27		
	Annual Payroll	133,746	5.9%		29	
	Estimated Receipts	434,161	3.1%			95
11. Paper, Paperboard, and Deinked Market Pulp Mills	Establishments	24	0.4%			
	Employment	2,940	3.5%	123		
	Annual Payroll	149,712	6.7%		51	
	Estimated Receipts	1,112,318	7.8%			378
12. Paper-Based Product Manufacturers	Establishments	16	0.3%			
	Employment	520	0.6%	33		
	Annual Payroll	15,713	0.7%		30	
	Estimated Receipts	104,528	0.7%			201
13. Pavement Mix Producers (asphalt and aggregate)	Establishments	15	0.3%			
	Employment	228	0.3%	15		
	Annual Payroll	2,990	0.1%		13	
	Estimated Receipts	41,370	0.3%			181
14. Plastics Reclaimers	Establishments	63	1.2%			
	Employment	1,499	1.8%	24		
	Annual Payroll	43,090	1.9%		29	
	Estimated Receipts	126,276	0.9%			84

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Business Category	Data Type	Estimates of Recycling and Reuse Activity	Percent of Total for All Categories	Employees per Establishment	Annual Payroll per Employee	Estimated Receipts per Employee
15. Plastics Converters	Establishments	309	5.8%			
	Employment	16,546	19.6%	54		
	Annual Payroll	503,281	22.4%		30	
	Estimated Receipts	2,476,497	17.5%			150
16. Rubber Product Manufacturers	Establishments	15	0.3%			
	Employment	271	0.3%	18		
	Annual Payroll	9,363	0.4%		35	
	Estimated Receipts	56,880	0.4%			210
17. Steel Mills	Establishments	1	0.0%			
	Employment	333	0.4%	333		
	Annual Payroll	17,316	0.8%		52	
	Estimated Receipts	129,036	0.9%			388
18. Iron and Steel Foundries	Establishments	77	1.4%			
	Employment	4,916	5.8%	64		
	Annual Payroll	141,878	6.3%		29	
	Estimated Receipts	582,238	4.1%			118
19. Other Recycling Processors/Manufacturers	Establishments	31	0.6%			
	Employment	871	1.0%	28		
	Annual Payroll	20,854	0.9%		24	
	Estimated Receipts	84,661	0.6%			97
Recycling Subtotals	Establishments	2,525	47.3%			
	Employment	62,657	74.4%	25		
	Annual Payroll	1,892,568	84.1%		30	
	Estimated Receipts	12,293,996	86.7%			196

Reuse and Remanufacturing Industry Economic Activity						
20. Computer and Electronic Appliance Demanufacturers	Establishments	34	0.6%			
	Employment	956	1.1%	28		
	Annual Payroll	24,696	1.1%		26	
	Estimated Receipts	125,120	0.9%			131
21. Motor Vehicle Parts (used)	Establishments	773	14.5%			
	Employment	5,288	6.3%	7		
	Annual Payroll	108,208	4.8%		20	
	Estimated Receipts	653,927	4.6%			124
22. Retail Used Merchandise Sales	Establishments	1,895	35.5%			
	Employment	13,845	16.4%	7		
	Annual Payroll	185,931	8.3%		13	
	Estimated Receipts	877,939	6.2%			63
23. Tire Retreaders	Establishments	68	1.3%			
	Employment	893	1.1%	13		
	Annual Payroll	20,971	0.9%		23	
	Estimated Receipts	111,147	0.8%			124
24. Wood Reuse	Establishments	32	0.6%			
	Employment	375	0.4%	12		
	Annual Payroll	4,503	0.2%		12	
	Estimated Receipts	29,088	0.2%			78
25. Materials Exchange Services	Establishments	4	0.1%			
	Employment	19	0.0%	5		
	Annual Payroll	728	0.0%		38	
	Estimated Receipts	7,456	0.1%			392
26. Other Reuse	Establishments	11	0.2%			
	Employment	212	0.3%	19		
	Annual Payroll	12,315	0.5%		58	
	Estimated Receipts	83,501	0.6%			394
Reuse and Remanufacturing Subtotals	Establishments	2,817	52.7%			
	Employment	21,588	25.6%	8		
	Annual Payroll	357,352	15.9%		17	
	Estimated Receipts	1,888,178	13.3%			87

GRAND TOTALS	Establishments	5,342	100.0%			
Recycling, Reuse and Remanufacturing	Employment	84,245	100.0%	16		
	Annual Payroll	2,249,919	100.0%		27	
	Estimated Receipts	14,182,174	100.0%			168

Insight into California's recycling and reuse industry can be obtained by comparing the relative sizes of individual business categories and groups of categories that are related in terms of materials recycled or the industry sector in which they belong.

COMPARISON OF THE RECYCLING SECTORS TO THE REUSE SECTOR

A noticeable distinction exists between the recycling sector and the reuse sector in terms of the size of establishments and average annual payroll. The recycling establishments have an average of 25 employees each, with an average annual payroll per employee of \$30,000. Comparatively, the reuse sector is made up of smaller establishments – an average of 8 employees per establishment – with an average annual payroll of \$17,000 per employee. Although the reuse and remanufacturing sector comprises 53 percent of total establishments, it makes up only 26 percent of total employees, 16 percent of payroll, and 13 percent of receipts.¹⁹

It is assumed that differences in employee pay between recycling sector and reuse sector establishments closely follow the level of skill and training required of employees. Recycling manufacturing, which contributes heavily to the overall recycling statistics, generally requires employees of higher skill and training than is normally required of employees of reuse establishments. Employees of higher skill and training are paid more than employees of lesser skill and training. It should be noted that remanufacturing jobs, which were not well-characterized by this study, are more likely to have similar skill and training requirements to recycling manufacturing jobs and would pay higher wages than the average reuse sector job.

The difference in average employees per establishment between the recycling and reuse sectors can come from several sources, although two are most likely: (1) whether continuous production processes are employed; and (2) whether economies of scale produce improved production efficiency. Continuous production processes are normally employed to save energy, avoid production startup/shutdown inefficiencies, or cover high monthly fixed costs (such as capital equipment finance costs) by increasing daily production and revenues. Establishments that operate three shifts per day employ more persons than establishments of similar hourly production capacity that operate one shift per day. Processes where economies of scale reduce unit costs apply to those instances where overhead costs are significantly streamlined or where larger-sized capital equipment is more efficient than smaller-sized equipment. Because the capital equipment and processes employed in recycling manufacturing favor continuous production and economies of scale, it is not unexpected that recycling establishments are on average larger than reuse sector establishments (which rely more heavily on manual labor).

COMPARISON OF RECYCLING COLLECTION AND PROCESSING TO RECYCLING MANUFACTURING

Recycling categories that are focused locally on recovering materials from commercial, industrial, and residential waste streams include establishments that collect and process recyclables for shipment to the recycling manufacturing industry. These local recycling collection and processing establishments include:

- Government staffed residential curbside collection;
- Privately-staffed residential curbside collection;
- Compost and miscellaneous organics products producers;
- Materials recovery facilities; and

¹⁹ These reuse and remanufacturing figures are thought to represent the minimum amount of economic activity captured by the methodology because remanufacturing activities are often included with traditional manufacturing industries that were not included in this study. Several years ago Boston University estimated remanufacturing activities on the national level (Professor Robert T. Lund, *The Remanufacturing Industry: Hidden Giant*, 1996). That study suggested that reuse and remanufacturing categories may be as much as three times larger than that characterized by this study's methodology.

■ Recyclable material wholesalers.

Alternatively, establishments in the recycling manufacturing sector are considered to be downstream consumers of recovered materials who rely on local collectors and processors for their supply of materials. When the two groups are compared, local collection and processing make up approximately 28 percent of total recycling employment and 38 percent of recycling receipts, whereas downstream manufacturing makes up the remaining 72 percent of recycling employment and 62 percent of recycling receipts. This suggests that public policy to encourage recycling and discourage disposal along with public and private investment in local recyclables collection and processing infrastructure pays great dividends in supporting significant downstream private recycling economic activity.

COMPARISON OF INDUSTRY SECTOR SIZES

Figures 4-1 and 4-2 illustrate the size of each industry sector. As Figures 4-1 and 4-2 show, and as was discussed above, the economic size of the recycling manufacturing sector leads the recycling collection, recycling processing, and reuse sectors in size.

FIGURE 4-1
EMPLOYMENT BY INDUSTRY SECTOR

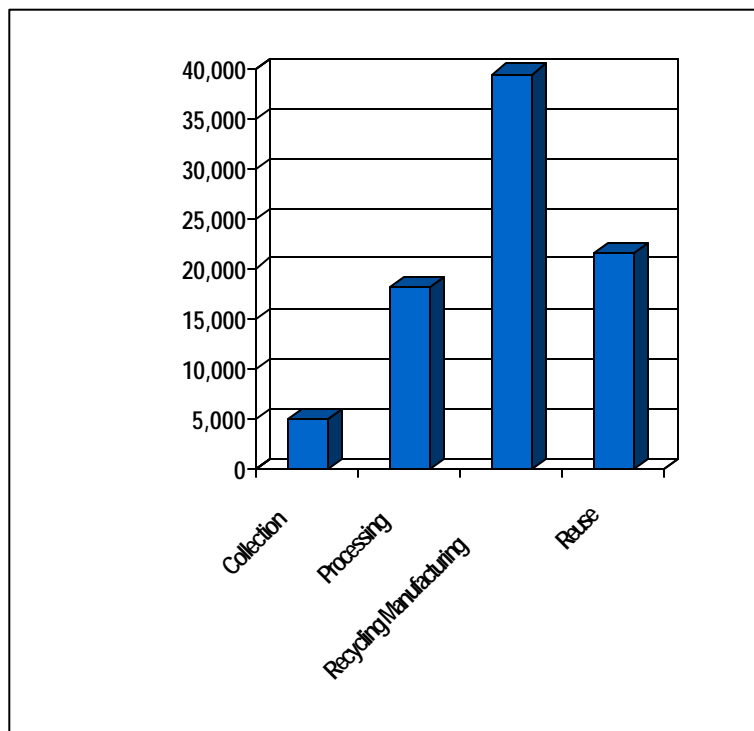
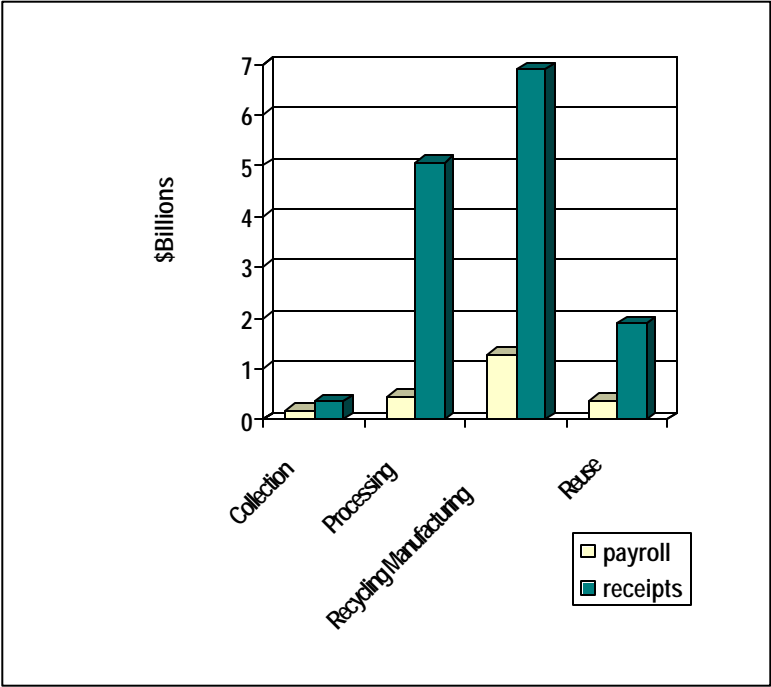


FIGURE 4-2
PAYROLL AND RECEIPTS BY INDUSTRY SECTOR



Figures 4-3 and 4-4 show how the size of California’s major recyclable materials manufacturing industries compare to each other. As the figures show, manufacturing recycled-plastic containing products leads the other major materials groups.

FIGURE 4-3
RECYCLING MANUFACTURING INDUSTRY EMPLOYMENT BY MAJOR MATERIAL GROUP

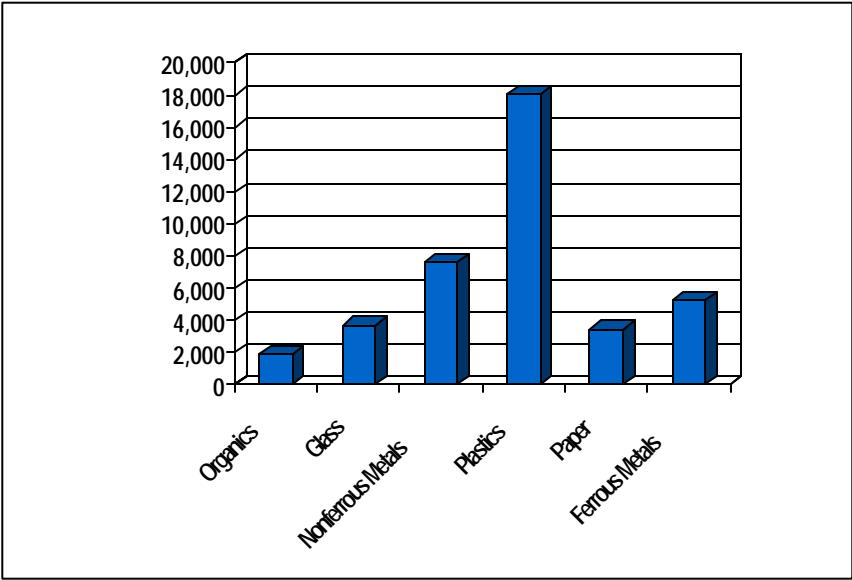
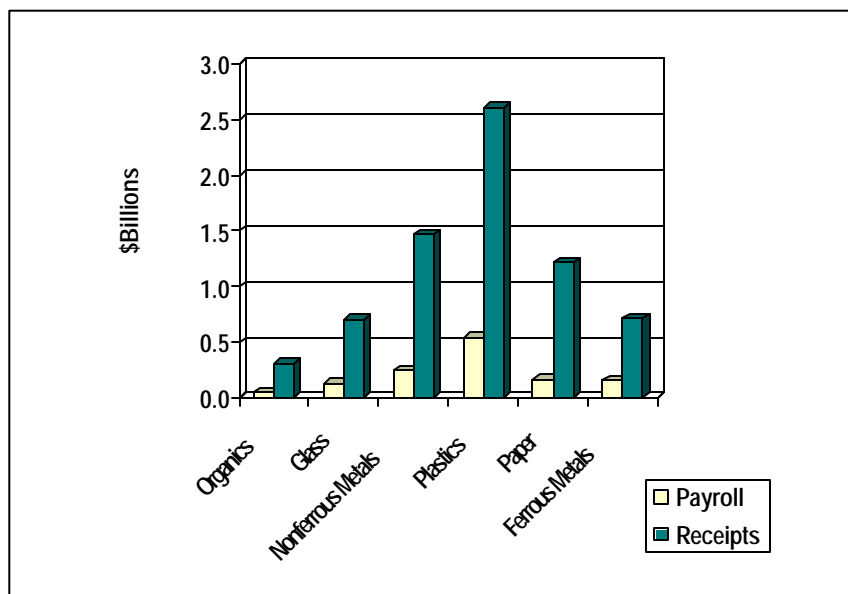


FIGURE 4-4
RECYCLING MANUFACTURING INDUSTRY PAYROLL AND RECEIPTS BY MAJOR MATERIAL GROUP



The amount of materials recycled, in combination with the underlying value of each raw material, help explain why some major material groups shown in Figures ES-3 and ES-4 rank higher than others. When large quantities of a high-value commodity are returned to the stream of commerce, the large amount of intrinsic value returned to the economy can support more jobs and economic activity than if a lesser amount or lower value commodity is returned to the stream of commerce. Plastics and non-ferrous metals are at the top end of the value scale, ferrous metals and paper are in the middle, and glass and compost are at the low end of the value scale.

When both amount recycled and value are considered together, the relative sizes of the various material groups can be explained. Similarly, estimates can be made of the economic impact that results from increased diversion of various materials.

LARGEST CONTRIBUTORS

Upon closer examination of Table 4-3, over half of the economic activity for the entire recycling and reuse industry is accounted for by the following four categories:

- Paper, paperboard, and deinked market pulp mills;
- Plastics converters;
- Recyclable material wholesalers; and
- Retail used merchandise sales.

These four categories alone account for 56 percent of all employees, 53 percent of wages, and 64 percent of total receipts.

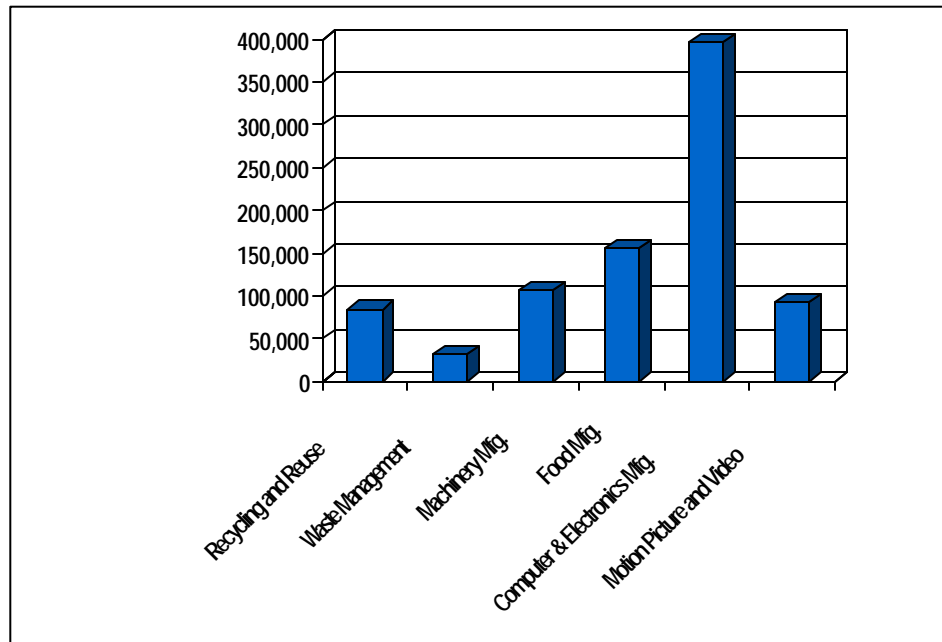
The data found in Table 4-3 can be compared to other industries and state averages to put it into perspective. The recycling and reuse industry composes 0.6 percent of all paid jobs in

California, and directly contributes to 0.3 percent of gross state product.²⁰ Also, the average wage paid by the recycling and reuse industry is \$26,700. While this is significantly greater than minimum wage, it is approximately \$6,000 per year less than California's average for all wage and salary jobs. In several other states that commissioned comparable REI studies, the recycling and reuse industry's average wage was above the state average for all jobs. One explanation for the difference is that the higher wage jobs tend to be in the manufacturing sector of the recycling and reuse industry, and California's economy is less manufacturing based than the economies of the other states.

THE RECYCLING AND REUSE INDUSTRY IN PERSPECTIVE

Figures 4-5, 4-6, and 4-7 show how California's recycling and reuse industry compares to other select California industries.²¹

FIGURE 4-5
COMPARISON OF INDUSTRY EMPLOYMENT



²⁰ Average wage and total jobs data come from the U.S. Bureau of Economic Analysis, regional accounts data, regional economic profile for California for 1997 wage and salary jobs. Gross state product data comes from the U.S. Bureau of Economic Analysis, "Gross State Product in Current Dollars, 1992-1998" table using data for 1997.

²¹ Comparative industry information comes from the 1997 Economic Census (U.S. Census Bureau) for the following industries: Waste Management – NAICS 562 Waste Management and Remediation Services minus 56292 Materials Recovery Facilities; Machinery Manufacturing – NAICS 333; Food Manufacturing – NAICS; Computer and Electronics Manufacturing – NAICS 334; Motion Picture and Video Industries – NAICS 5121.

FIGURE 4-6
COMPARISON OF ANNUAL WAGES PER JOB

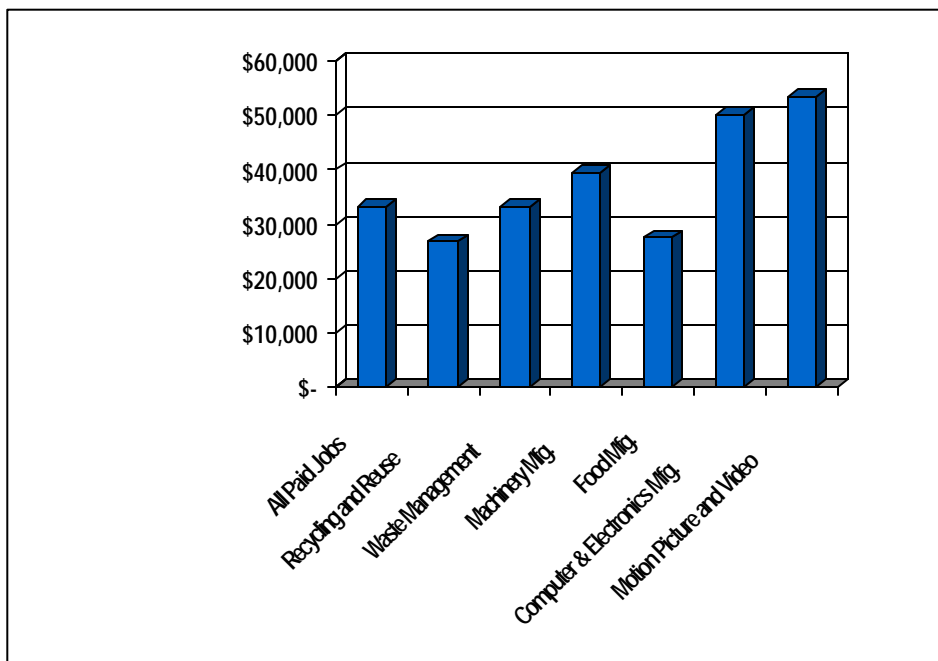
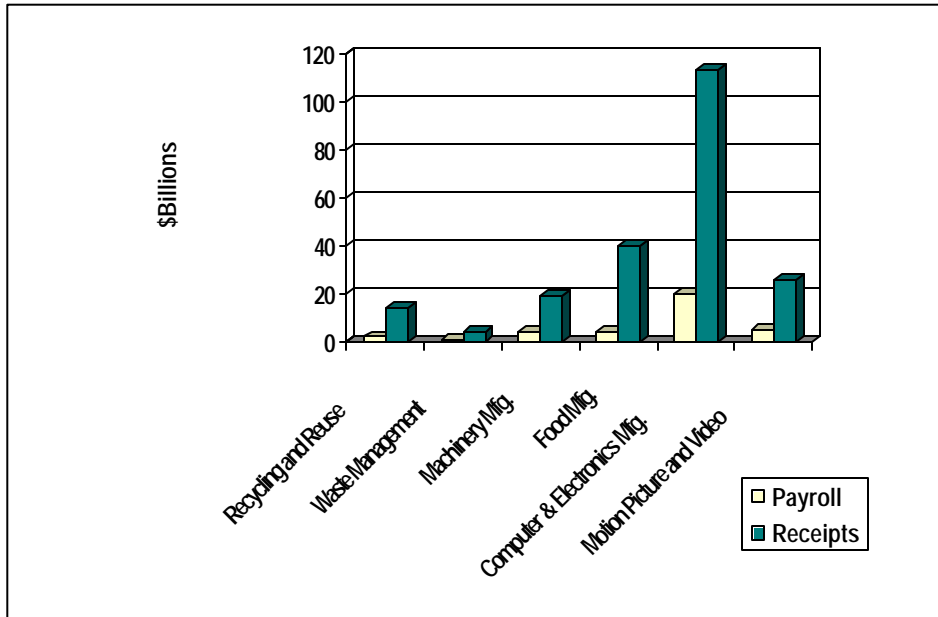


FIGURE 4-7
COMPARISON OF TOTAL WAGES AND SALES



As the figures show, the recycling and reuse industry is a significant industry as compared to other major California industries. Despite the fact that more discards are disposed than recycled, it is not surprising that the recycling and reuse industry is larger than the waste management industry. This is because recycling and reuse are inherently value-adding, whereas disposal is not, and value-adding processes support jobs and economic activity.

4.4 ACCURACY AND COMPLETENESS OF RESULTS

The results of this study for the categories identified are thought to be realistic and generally conservative. The results for categories which used existing U.S. Census data are believed to be the most accurate, followed by data for survey categories, while the derivations are likely to be the least accurate because of the limited amount of available data for estimations. Census data, although updated yearly, lags in publication by three years so that data is not as current as data for survey categories. Survey data is current; however, confidence intervals for total employment, payroll, and receipts for certain categories are quite large because of the small number of establishments in those categories.

The study did encounter a number of limitations that impacted the ability to accurately capture all recycling and reuse activity. The limitations of the study include:

- Survey data asked for intervals rather than discrete numbers;
- Certain business categories that could be considered part of the recycling and reuse industry were excluded because data were not available. Most notable is equipment remanufacturers, for which only a one-time national-level study was conducted, and for which lists of contact information are not maintained. In other cases, such as repair shops, there is significant debate on the types of repair activities that should be counted (e.g., automobile repair establishments).
- Many establishments in rapidly growing recycling and reuse sectors, or those that were recycling non-traditional materials (such as fluorescent lamps and carpets) may not have been fully listed in recycling directories, and thus their activity may be underrepresented in the overall results.
- Some derivations, such as that for plastics converters, are based on the best of several less-than-desirable options available; it is very difficult to assess the accuracy of those results.

Although the study was not able to capture every possible type of recycling and reuse activity, it is reasonably accurate for the categories shown and conservatively estimates the total amount of recycling and reuse activity taking place.

5.1 OVERVIEW

This study modeled the economic values of twenty-six recycling or reuse categories. Further calculations were made to estimate selected state government revenues that would be associated with the levels of economic activity that were identified through the modeling process. This section provides an overview of the process of input-output modeling, its strengths, its limitations, and its adaptation to this study. This section also defines the terms used and what the model output data represents. The following section provides the results in tabular form.

5.1.1 INPUT-OUTPUT MODELING PROCESS AND LIMITATIONS

Economic values or economic effects studies are usually conducted with input-output (I-O) econometric models of a regional economy. Input-output modeling allows researchers to investigate the interdependencies that industries, institutions, and households have with each other in a region of study. I-O models, therefore, relate the products made within a region and the products consumed by industries and households in that same region.

At a basic level, any industry's or institution's output (usually its gross sales) requires employees, materials, utilities, capital investments, financing, maintenance, equipment, and service inputs. The probability that a firm purchases its inputs locally (meaning within the region being modeled) is estimated in the I-O model. Estimates of an industry's inputs mix and whether those inputs are purchased within the region being modeled are based on national and regional industrial surveys.

Primary survey information to update the national or regional statistics is needed to improve the quality of the model output, particularly where the industry segment under study may differ from national or regional averages. As was discussed previously in the Study Methodology section, this study performed limited surveys to obtain additional intermediate input data. Furthermore, it made use of in-house data from previous county-level and state-level modeling projects to further improve the quality of the model that was produced.

There are important limitations to these models that must be acknowledged. First and foremost, absent highly detailed and costly local industry surveys, which was not done for this study, national and regional averages for major industrial input categories (the production functions) and the likelihood of a local purchase of inputs for the industries that were studied (regional purchasing coefficients) were still heavily relied on. Industries that fall within general industrial categories normally have very similar industrial input characteristics. A plastics firm that produces finished goods from recycled stock will be configured very similarly to a plastics firm that produces goods primarily from virgin inputs. Except for the source of their commodity input into production and the physical configuration of their processing machinery, their overall remaining operational characteristics – transportation, utilities, services, maintenance, financial inputs, etc. – are likely to be very similar. Consequently, in most instances, production characteristics of existing firms in the state of study provided a very good first pass at identifying intra-regional linkages and supply chains of goods and services required for production. Although the I-O model has information on up to 537 industries, there is no specific set of "recycling and reuse" industries. Consequently, the models that were produced were significantly modified to accept recycling and reuse industries distinctly. Furthermore, the use of in-house data and additional surveys

for select recycling and reuse industries enhanced the quality of the model output for this study.

Other limits in these types of models include:

- Difficulties in capturing economies of scale, particularly for industries with relatively small numbers of establishments, where establishment-to-establishment variation may be significant (the current input values or production functions are, therefore, initially constant);
- An inability to identify input substitutes – especially in new technologies or in instances where input modes have changed;
- Dated data on industrial performance and purchases, particularly for industries that are newly-emerging or rapidly changing;
- In-state and out-of-state purchases of commodities within a study area are fixed (regional purchasing coefficients must be adjusted if it is suspected that the regional averages are not right); and
- An implicit assumption that input commodity supply is infinite and perfectly elastic.

I-O models, therefore, are just that – models – that simulate industrial inter-dependencies in the current economy under study. I-O models are not necessarily good models for forecasting because they model the existing economy, and do not forecast the net impact of replacing a virgin-commodity establishment with a recycled-commodity establishment, for example. Furthermore, the results for one region reflect the economy of that particular region and generally are not transferable to other regions. I-O models, therefore, have limits. Nevertheless, I-O models are comparably much less expensive to produce than more involved models, and do an excellent job of estimating the role a particular industry has (such as the recycling industry) on a specific economy.

The generic term “economic impact” is frequently used to describe a set of economic activities in a region. This term often suffers from serious misapplication. There are several kinds of economic activities that may occur within a particular region. For example:

- Firms may produce goods or provide services for export outside the region. They attract outside funds into the region that supports employment, industrial purchases, and household spending.
- Firms may substitute locally produced commodity inputs for those that previously were purchased from outside the region. In this case funds are retained in the region and flow to local suppliers to an industry.
- Firms may produce goods and services for local consumption (either by industries or by households). Although they may help to retain funds in the region, they may not cause significant additional economic activity.

I-O models identify the overall size and contribution of an industry – its *economic effect* or *economic value* – to the area mix of economic activity along with interdependencies that exist between it and other firms or service suppliers. In other words, the strength of linkages that exist among industries and the overall value (output, incomes, and jobs) of their production. The impact of an industry hasn’t yet been determined.

In the case of firms that produce finished goods for export outside a region, there is a measurable *economic impact* – were it not for the external demand for the locally-produced product, the economic activity would not be in the local economy.

A much harder measure of potential economic impact falls into the category of import substitution. If a region is able to develop indigenous industries that produce a good that substitutes for a good that is imported, then that industry is *retaining* dollars in the state that

used to be exported. An industry that produces a good using recycled feedstock that is supplied locally will create a product that substitutes local inputs for non-local inputs. Recycling industries often fit into the import substitution category, particularly in states without virgin feedstock production infrastructures. By utilizing recycled content, they are purchasing locally and, therefore, stimulating indigenous economic activity.

This study generally reserves the use of the term *economic impact* only for industries that have verifiable levels of exports – where the output that they are producing is a genuine and real increase in industrial output – or for true import substitutes. To claim economic impacts over and above those just mentioned would involve much more extensive industrial measures for each category of establishments that was assessed in this study, and over a period of time.

This study does, however, isolate *total economic values* – estimates, by category, of the value of economic inter-relationships that exist for the industries. These values are the intrinsic worth of a set of industrial activities to the nation. They represent a slice of the economic pie from a particular point of view.

In summary, economic models are and only can be estimates of inter-industrial linkages and regional values. They are based on an amalgam of federal, county, and state data, academic procedures, along with some survey-derived direct data, all compiled with due diligence for accuracy and reasonableness. Consequently, although an inter-industrial accounting framework is implied, all estimates are simulations of economic values based on the data employed and the assumptions implicit in the modeling.

5.1.2 KINDS OF ECONOMIC INFORMATION PRODUCED BY I-O MODELS

Input-output models produce many kinds of data for analysis and decision making. The more useful results for industrial leaders, planners, and policy makers are estimates of (1) total industrial output, (2) personal income, (3) value added, and (4) jobs. These are the categories of economic activity that are reported in detail in the data tables that follow this section. These terms are defined below:

- *Total industrial output* for most private industries is simply gross sales. For public or quasi-public institutions this normally includes all public outlays, along with the value of government sales and other subsidies received, to isolate the current economic value of their output to the citizens or the area served.
- *Personal income* includes the wages and salaries of employees and proprietors, normal profits to sole proprietors, and an estimate of the cash value of all benefits (e.g., social insurance, retirement, and medical benefits).
- *Value added* is a measure of gross regional product. It includes all personal income (employment compensation, incomes to sole proprietors) plus property incomes (dividends, interests, and rents), and indirect tax payments (primarily excise and sales taxes paid by individuals to businesses).
- *Jobs* is the number of full- and part-time positions in the economy, not the number of full-time-equivalents.²² This distinction is important because the relationship between job growth and labor force growth is very different in different industries. Some industries rely heavily on semi-skilled part-time labor. Other industries generally only produce full-time skilled jobs. It is always important, when possible, to quantitatively assess whether the jobs that are stimulated are part-time or full-time or higher-paying versus lower-paying.

²² For example, a restaurant may employ 20 people on a half-time basis (20 jobs) to fill its labor requirement of 10 full-time-equivalents.

Economic data is further reported as direct, indirect, induced, and total economic effects.

- *Direct effects* refer to the operational characteristics of the firms or institutions that are studied. This study measured the apparent value of twenty-six categories of recycling and reuse establishments. The direct output of these entities is, therefore, their reported gross sales. The direct jobs are the jobs that are associated with those establishments. The direct personal income contains their reported payments to all employees, plus an additional estimate of benefit values and of returns to sole proprietors. The estimate of benefit values and returns to sole proprietors were based on industrial averages in industries that are similar to the recycling and reuse industries included in this study.
- *Indirect effects* measure the value of additional economic demands that the direct firms or institutions place on supplying industries in the region. When firms produce goods or conduct business or when public entities provide public goods or services, they must make many purchases. Some of these are from suppliers in the area. Some are not. Public utilities, communications systems, fuel, wholesale goods and services, manufactured goods, financial and legal services, raw and processed commodities, and a variety of professional services are necessary to produce the direct values described above.
- *Induced effects* accrue when workers in the direct and indirect industries spend their earnings on goods and services in the region. Induced effects can also be called household effects, and the terms are often used inter-changeably. When workers in direct and indirect industries purchase goods and services for household consumption, they, in turn, stimulate another layer of the economy. Most induced activity accrues to retail, services, and finance, insurance, and housing spending. Because employment is stimulated in these industries as well, *their* demands for inputs increase, yielding an additional round or additional rounds of indirect purchases and additional rounds of induced activity. The I-O models solve for these iterative rounds of transactions until all of the possible inter-industrial transactions have been accumulated.
- *Total economic effects* are the sum of direct, indirect, and induced effects. They are all of the transactions attributable, either directly or indirectly, to the activities of establishments in the business categories included in this study.

The term *multiplier* or *multiplier effect* is frequently used when referring to economic effects or economic impacts. There are different kinds of multipliers – this study reports two types. The Type I multiplier identifies the value of direct and indirect transactions – e.g., the output of a business category and all other output that it purchases from its suppliers in the region – relative to the value of only the direct transactions. The Type II multiplier identifies the value of all economic transactions (direct, indirect, and induced) that are stimulated in the economy by an industry under study, including the personal spending of employees throughout the supply chain whose economic activity is apportioned to the industry, relative to the value of only the direct transactions.

5.2 RESULTS

Table 5-1 shows estimates of economic activity accruing to establishments in business categories that provide goods or services to recycling and reuse industry establishments. The category Other Indirect Establishments shown in the table includes all other indirect establishments that provide goods or services (such as office supply companies, accounting firms, legal firms, building and landscape maintenance firms, etc.).

As Table 5-1 shows, the indirect economic activity accruing to Recycling and Reuse Equipment Manufacturers and Transporters composes a significant portion of the total indirect effects, representing 10-13 percent depending on the data type that is considered. It

is important to note that the data for Recycling and Reuse Equipment Manufacturers is based on a statistical analysis of survey data and therefore represents complete data for those types of establishments located in a state regardless of where they sell their equipment. Totals for the other categories represent indirect activity relating to only the 26 categories of recycling and reuse industry establishments located in California that were investigated for this study.

TABLE 5-1
ESTIMATES OF INDIRECT ECONOMIC ACTIVITY OF SELECT SUPPORT BUSINESS CATEGORIES

(ANNUAL PAYROLL AND ESTIMATED RECEIPTS ARE IN \$1,000)

Business Category	Data Type	Value
Recycling and Reuse Equipment Manufacturers ^[1]	Employment	3,010
	Annual Payroll	60,146
	Estimated Receipts	537,866
Consulting/Engineering ^[2]	Employment	507
	Annual Payroll	19,729
	Estimated Receipts	40,756
Transporters ^[2]	Employment	1,834
	Annual Payroll	194,065
	Estimated Receipts	283,917
Other Indirect Establishments ^[2]	Employment	44,884
	Annual Payroll	1,608,358
	Estimated Receipts	5,793,587
Support Businesses Totals	Employment	50,235
	Annual Payroll (\$1,000)	1,882,298
	Estimated Receipts (\$1,000)	6,656,126

Notes:

^[1] Data for Recycling and Reuse Equipment Manufacturers are based on a statistical analysis of survey results.

^[2] Data come from modeling output and reflect the indirect activity stimulated by the 26 direct categories of recycling and reuse establishments targeted by this study for direct data.

Listed below in Table 5-2 are the titles of data tables that follow and a description of the information they contain.

TABLE 5-2
GUIDE TO DATA TABLES

Number	Title	Information Contained
Table 5-3	Recycling and Reuse Industry Economic Values and Multipliers	Shows direct, indirect, and induced economic values and multipliers for the 26 categories of recycling and reuse establishments
Table 5-4	Recycling and Reuse Industrial Multipliers Compared to Multipliers for Other Industries	Shows multipliers for the recycling and reuse industry as compared to multipliers for other major industrial sectors
Table 5-5	Summary of Recycling & Reuse Industry Effects on Own-Source State Government Revenues	Shows state taxes, charges and fees, miscellaneous revenues, and total state revenues associated with direct and total economic values for the 26 categories of recycling and reuse establishments

TABLE 5-3
RECYCLING AND REUSE INDUSTRY ECONOMIC VALUES AND MULTIPLIERS

	Jobs (Actual)				Jobs Multiplier		Personal Income (in \$ Millions)				Income Multiplier		Industrial Output (in \$ Millions)				Output Multiplier		Value Added (in \$ Millions)				Value Added Multiplier	
	Direct	Indirect	Induced	Total	Type I	Type II	Direct	Indirect	Induced	Total	Type I	Type II	Direct	Indirect	Induced	Total	Type I	Type II	Direct	Indirect	Induced	Total	Type I	Type II
Recycling Collection																								
1. Government Staffed Residential Curbside Collection	1,900	120	750	2,770	1.06	1.46	66	5	25	96	1.08	1.45	131	14	68	212	1.11	1.62	114	7	41	162	1.07	1.42
2. Private Staffed Residential Curbside Collection	3,100	215	1,506	4,821	1.07	1.56	133	9	50	192	1.06	1.44	213	24	136	373	1.11	1.75	175	14	82	270	1.08	1.55
Subtotal	5,000	335	2,256	7,591	1.07	1.52	199	14	74	287	1.07	1.44	344	38	203	585	1.11	1.7	289	21	123	432	1.07	1.5
Recycling Processing																								
3. Compost and Miscellaneous Organics Producers	1,892	1,871	1,400	5,163	1.99	2.73	60	71	46	177	2.19	2.95	305	188	126	619	1.62	2.03	78	109	76	263	2.4	3.37
4. Materials Recovery Facilities (MRF's)	2,606	1,135	1,307	5,048	1.44	1.94	74	42	41	156	1.57	2.12	206	100	111	418	1.49	2.02	89	60	67	216	1.67	2.41
5. Recyclable Material Wholesalers	13,710	5,307	8,687	27,704	1.39	2.02	366	121	171	658	1.33	1.8	4,549	1,446	2,235	8,231	1.32	1.81	506	141	221	868	1.28	1.72
Subtotal	18,208	8,313	11,394	37,915	1.46	2.08	500	234	258	992	1.47	1.98	5,060	1,735	2,472	9,267	1.34	1.83	673	310	364	1,347	1.46	2
Recycling Manufacturing																								
6. Glass Container Manufacturing Plants	3,013	2,416	2,558	7,987	1.8	2.65	138	99	84	321	1.72	2.32	652	288	228	1,168	1.44	1.79	189	157	138	484	1.83	2.56
7. Glass Product Producers (other recycled uses)	697	223	196	1,115	1.32	1.6	9	9	6	25	1.96	2.65	53	25	18	95	1.47	1.8	13	14	11	38	2.09	2.89
8. Nonferrous Secondary Smelting and Refining Mills	1,597	2,869	2,547	7,013	2.8	4.39	67	119	70	256	2.79	3.83	708	339	181	1,228	1.48	1.73	88	193	111	392	3.19	4.45
9. Nonferrous Product Producers	1,467	1,396	1,283	4,146	1.95	2.83	50	59	39	148	2.18	2.96	330	173	105	607	1.52	1.84	64	93	63	221	2.45	3.43
10. Nonferrous Foundries	4,550	1,579	2,208	8,337	1.35	1.83	140	67	73	279	1.47	1.99	434	202	198	834	1.46	1.92	215	106	120	441	1.49	2.05
11. Paper, Paperboard, and Deinked Market Pulp Mills	2,940	4,385	3,715	11,039	2.49	3.75	155	181	119	455	2.17	2.94	1,112	513	324	1,949	1.46	1.75	223	283	196	702	2.27	3.15
12. Paper-Based Product Manufacturers	520	418	366	1,304	1.8	2.51	16	17	12	45	2.06	2.79	105	48	32	184	1.46	1.76	24	27	19	71	2.12	2.91
13. Pavement Mix Producers (asphalt and aggregate)	228	262	145	635	2.15	2.79	3	11	5	18	4.31	5.82	41	28	13	82	1.67	1.98	9	16	8	33	2.68	3.53
14. Plastics Reclaimers	1,499	941	905	3,345	1.63	2.23	44	36	28	108	1.82	2.47	126	62	47	236	1.49	1.87	59	57	47	163	1.97	2.76
15. Plastics Converters	16,546	10,392	9,988	36,926	1.63	2.23	513	423	330	1,266	1.82	2.47	2,477	1,219	929	4,625	1.49	1.87	689	667	544	1,900	1.97	2.76
16. Rubber Product Manufacturers	271	320	239	830	2.18	3.06	10	13	8	30	2.32	3.13	57	34	21	112	1.6	1.97	12	20	13	44	2.66	3.76
17. Steel Mills	333	623	512	1,469	2.87	4.41	18	26	16	60	2.43	3.3	129	73	43	245	1.57	1.9	22	42	26	90	2.88	4.04
18. Iron and Steel Foundries	4,916	2,809	2,999	10,723	1.57	2.18	150	113	94	357	1.75	2.38	582	301	253	1,136	1.52	1.95	171	177	153	501	2.03	2.93
19. Other Recycling Processors/Manufacturers	871	379	437	1,687	1.44	1.94	31	18	17	65	1.57	2.12	85	41	46	171	1.49	2.02	38	26	28	92	1.67	2.41
Subtotal	39,448	29,012	28,098	96,557	1.74	2.45	1,344	1,189	899	3,433	1.89	2.55	6,890	3,345	2,436	12,671	1.49	1.84	1,817	1,877	1,476	5,170	2.03	2.84
Re-Use/Remanufacturing																								
20. Computer and Electronic Appliance Demanufacturers	956	553	520	2,029	1.58	2.12	25	23	17	66	1.92	2.59	125	70	47	242	1.56	1.93	34	36	28	98	2.04	2.86
21. Motor Vehicle Parts (used)	5,288	3,387	2,916	11,591	1.64	2.19	128	144	95	367	2.12	2.86	654	417	260	1,331	1.64	2.04	154	225	157	536	2.46	3.48
22. Retail Used Merchandise Sales	13,845	4,838	4,650	23,332	1.35	1.69	257	180	153	591	1.7	2.3	878	462	419	1,759	1.53	2	403	286	253	942	1.71	2.34
23. Tire Retreaders	893	418	487	1,798	1.47	2.01	29	17	16	61	1.57	2.13	111	45	43	200	1.41	1.8	49	26	26	101	1.52	2.05
24. Wood Reuse	375	204	137	716	1.54	1.91	5	8	5	17	2.67	3.6	29	22	12	63	1.75	2.17	6	11	8	24	2.91	4.19
25. Materials Exchange Services	19	28	21	68	2.46	3.56	1	1	1	3	2.31	3.14	8	3	2	12	1.35	1.58	1	2	1	4	2.89	4.12
26. Other Reuse	212	543	428	1,183	3.56	5.58	19	21	14	54	2.07	2.8	84	55	38	176	1.65	2.11	26	33	23	82	2.31	3.22
Subtotal	21,588	9,970	9,159	40,717	1.46	1.89	465	394	301	1,159	1.85	2.49	1,888	1,073	821	3,783	1.57	2	673	618	496	1,787	1.92	2.66
Total All Groups																								
	84,244	47,629	50,907	182,780	1.57	2.17	2,508	1,831	1,532	5,870	1.73	2.34	14,182	6,190	5,933	26,306	1.44	1.85	3,452	2,826	2,459	8,736	1.82	2.53

¹ Includes all full- and part-time jobs (not full-time equivalents).

TABLE 5-4
RECYCLING AND REUSE INDUSTRY MULTIPLIERS COMPARED TO MULTIPLIERS FOR OTHER INDUSTRIES

	Output		Jobs		Personal Income		Value Added	
	Type I	Type II	Type I	Type II	Type I	Type II	Type I	Type II
<i>Recycling & Reuse</i>	1.44	1.85	1.57	2.17	1.73	2.34	1.82	2.53
Agriculture	1.47	2.00	1.25	1.60	1.45	2.06	1.47	2.09
Mining	1.33	1.69	1.69	2.77	1.50	2.14	1.30	1.66
Construction	1.61	2.32	1.52	2.28	1.50	2.13	1.70	2.65
Manufacturing	1.67	2.20	2.07	3.31	1.85	2.65	1.91	2.80
Transportation, Communications, & Utilities	1.41	1.92	1.62	2.63	1.50	2.16	1.40	1.94
Wholesale Trade	1.32	1.92	1.37	2.17	1.30	1.87	1.26	1.79
Retail Trade	1.30	1.94	1.12	1.42	1.24	1.77	1.24	1.79
Financial, Insurance, & Real Estate	1.26	1.56	1.54	2.33	1.51	2.19	1.22	1.46
Services	1.41	2.19	1.27	1.86	1.29	1.85	1.38	2.16
Government	1.11	2.01	1.05	1.64	1.05	1.48	1.06	1.67
Other	1.00	2.07	1.00	1.13	1.00	1.41	1.00	1.65

SECTION 5

TABLE 5-5
SUMMARY OF RECYCLING & REUSE INDUSTRY EFFECTS ON OWN-SOURCE STATE GOVERNMENT REVENUES

	Direct Effects (in \$Millions)				Total Effects (in \$ Millions)			
	All State Taxes	Charges & Fees	Miscellaneous Revenues	All Own-Source State Government Revenues	All State Taxes	Charges & Fees	Miscellaneous Revenues	All Own-Source State Government Revenues
Recycling Collection								
1. Government Staffed Residential Curbside Collection	4.80	0.56	0.37	5.73	6.97	0.81	0.53	8.32
2. Private Staffed Residential Curbside Collection	9.74	1.14	0.74	11.63	13.99	1.64	1.07	16.70
Subtotal	14.54	1.70	1.11	17.35	20.96	2.45	1.60	25.02
Recycling Processing								
3. Compost and Miscellaneous Organics Producers	4.37	0.51	0.33	5.22	12.92	1.51	0.99	15.42
4. Materials Recovery Facilities (MRF's)	5.39	0.63	0.41	6.43	11.42	1.33	0.87	13.63
5. Recyclable Material Wholesalers	26.75	3.13	2.04	31.91	48.08	5.62	3.67	57.37
Subtotal	36.51	4.27	2.79	43.57	72.42	8.46	5.53	86.42
Recycling Manufacturing								
6. Glass Container Manufacturing Plants	10.07	1.18	0.77	12.02	23.40	2.74	1.79	27.93
7. Glass Product Producers (other recycled uses)	0.68	0.08	0.05	0.81	1.80	0.21	0.14	2.15
8. Nonferrous Secondary Smelting and Refining Mills	4.88	0.57	0.37	5.82	18.67	2.18	1.43	22.28
9. Nonferrous Product Producers	3.64	0.43	0.28	4.34	10.78	1.26	0.82	12.86
10. Nonferrous Foundries	10.23	1.20	0.78	12.21	20.39	2.38	1.56	24.33
11. Paper, Paperboard, and Deinked Market Pulp Mills	11.31	1.32	0.86	13.49	33.23	3.88	2.54	39.65
12. Paper-Based Product Manufacturers	1.18	0.14	0.09	1.41	3.29	0.38	0.25	3.92
13. Pavement Mix Producers (asphalt and aggregate)	0.23	0.03	0.02	0.28	1.34	0.16	0.10	1.60
14. Plastics Reclaimers	3.21	0.38	0.25	3.83	7.92	0.93	0.60	9.45
15. Plastics Converters	37.48	4.38	2.86	44.72	92.46	10.81	7.06	110.33
16. Rubber Product Manufacturers	0.70	0.08	0.05	0.83	2.19	0.26	0.17	2.61
17. Steel Mills	1.33	0.15	0.10	1.58	4.38	0.51	0.33	5.22
18. Iron and Steel foundries	10.95	1.28	0.84	13.07	26.05	3.04	1.99	31.08
19. Other Recycling Processors/Manufacturers	2.25	0.26	0.17	2.68	4.76	0.56	0.36	5.68
Subtotal	98.13	11.47	7.49	117.10	250.66	29.30	19.14	299.10
Reuse/Remanufacturing								
20. Computer and Electronic Appliance Demanufacturers	1.85	0.22	0.14	2.21	4.79	0.56	0.37	5.72
21. Motor Vehicle Parts (used)	9.36	1.09	0.72	11.17	26.81	3.13	2.05	31.99
22. Retail Used Merchandise Sales	18.79	2.20	1.44	22.42	43.15	5.04	3.30	51.49
23. Tire Retreaders	2.10	0.25	0.16	2.51	4.47	0.52	0.34	5.33
24. Wood Reuse	0.35	0.04	0.03	0.42	1.27	0.15	0.10	1.52
25. Materials Exchange Services	0.06	0.01	0.00	0.07	0.18	0.02	0.01	0.22
26. Other Reuse	1.41	0.17	0.11	1.69	3.96	0.46	0.30	4.72
Subtotal	33.93	3.97	2.59	40.49	84.63	9.89	6.46	100.98
Total All Groups	183.12	21.40	13.99	218.51	428.67	50.10	32.74	511.51

5.3 INTERPRETATION OF RESULTS

This section is intended to aid readers in interpreting the results of the tables in the previous section.

Economic values are most accurate at the business category level. Summing totals by groups of recycling or reuse activity for the state as a whole (as has been done in the tables) results in some degree of duplicated accounting of economic activity. This is true for any set of industrial assessments in any input-output modeling scenario – it is not a problem with recycling, *per se*, nor with this study, but arises simply because of the many business categories that are included in this study.

For example, direct sales by a raw commodity processor represent an input purchase by an industry producing a finished good for sale. A large portion of the raw commodity processor's direct sales is already reflected in the finished good industry's input purchases. In this case, then, aggregation biases the economic values in the subtotals and totals upwards. As a general rule, the higher the Type I multiplier (which is a measure of how strongly a firm depends on supplier inputs), the higher the probability of aggregation bias in reporting subtotals and totals. This is an inherent "Catch 22" in input-output modeling: to eliminate aggregation bias of this sort, the industries must be lumped together in the construction of the model so that inter-industrial transactions are properly accounted and the resulting multipliers are properly dampened. Doing so, however, eliminates the industrial detail that is desired.

Nevertheless, subtotals and totals have been produced so that relative comparisons can be made. Users of these findings, however, must be cautious to avoid claims about the recycling and reuse industry that may be unwarranted given that there is some degree of inflation in the subtotals or totals. Based on other modeling experience, it is believed that aggregation bias may have inflated the subtotals and totals by up to 15 percent, and possibly higher. It is important to note that this bias is associated with any total that is derived from indirect and induced information, including total economic activity, subtotal/total multipliers, and total government tax revenues. Alternatively, **totals derived only from direct information and government tax revenues derived from direct economic activity do not include bias**.

Multipliers reveal potential changes in the regional economy attributable to a change in direct activity in a particular industry in that same economy. Multipliers can be instructive for anticipating economic growth, in the case of a new or expanding firm, and economic decline, in the case of a plant closing. Economic multipliers are often misunderstood and therefore improperly used. Developers, planners, and decision-makers frequently use national level multipliers that are produced by the U.S. Bureau of Economic Analysis (BEA) as points of comparison. These multipliers are called RIMS II (Regional Input-Output Multiplier System), and they are widely used by development groups to support economic investment or public spending. Multipliers are available for over 500 industries in the categories of earnings, employment, and industrial output. Many users, however, mistakenly apply these statistics because they:

- Fail to account for regional production and cost of living differences (detailed multipliers are available at the state and county level, but project promoters often rely on national averages due to costs);
- Use the wrong multiplier to describe a phenomenon (multipliers for different categories of economic activity can vary substantially); or
- Seek to promote industries with the largest multipliers possible without consideration of either the appropriateness of the application or of the actual scope of local production.

The reader can be assured that this study produced Type I and Type II multipliers that are specific to California and are not directly derivative of national averages.

Before making any comparisons among multipliers, it is important to understand what influences them. Firms with strong linkages to area supplying firms or that pay relatively high wages may yield comparatively higher multipliers. Firms that are otherwise not linked strongly to local suppliers or that pay lower than average wages will usually produce lower multipliers. More urbanized areas and states with larger and more diversified economies have, on the average, much higher multipliers than less populated, more rural states for the same types of businesses.

Given the above guides to interpreting the data, there are a couple of general conclusions that can be drawn:

- California non-ferrous smelting and refining mills, steel mills, and wood reuse tended to have higher multipliers than establishments in other business categories.
- Investments in local recycling collection and processing and policies that encourage recycling and reuse yield significant total state government revenues from taxes, charges, fees, and miscellaneous revenues. For example, 58 percent of total recycling industry tax revenues arise from recycling manufacturing establishments and their indirect and induced economic activity.

SECTION 6

RECOMMENDATIONS FOR FUTURE STUDIES

This section summarizes the recommendations for replicating the study in future years. Recommendations are:

- Consider using the new NAICS system code, 56292, which is specifically for MRFs, instead of using survey data. Because of inconsistencies between the NAICS MRF data and other published data, MRFs were surveyed for this study.
- Narrow the definition of compost and organics producers. The definition of compost and organics producers was very broad, resulting in a large number of listings that were municipal mulching operations or only a small portion of a larger facility, such as a MRF or transfer station with very little organics economic activity.
- Conduct additional research on the industrial characteristics of recycling and reuse firms to improve the explanatory power of I-O models. This research should focus on the following areas:
 - Improving input-output tables (use, make, and total requirements) for critical recycling and reuse industries so that inter-industrial transactions are better understood. Furthermore, constructing similar tables for non-recycling industries will allow better comparisons between recycling and non-recycling businesses.
 - Tracking the throughput of major recycling commodities at state levels to the production of a final industrial or household good. For many industries there is not good information on the propensity of recyclables being purchased, processed, and manufactured into a consumer good within a state or region.
 - Identifying critical costs associated with the flow of recycled products into goods for final use.

Finally, follow-up studies that would be useful should be considered, including:

- Additional research to better document intermediate input statistics for recycling businesses and to enable comparisons between recycling and non-recycling businesses in the same industry;
- Estimating the amount of economic activity that can be attributed to public policy and legislated recycling and waste reduction goals; and
- Determining the amount of growth over today's baseline (as measured through this report) that could be realized by additional levels of recycling and reuse.

APPENDIX A

DESCRIPTION OF RECYCLING AND REUSE BUSINESS CATEGORIES

Table A-1 provides detailed descriptions of 30 recycling and reuse business categories, grouped into 5 industry segments. The table is intended to comprehensively include all business establishments undertaking recycling and reuse economic activities, as defined in Section 2.

Table A-1 lists *Standard Industrial Classification* (SIC) codes for each category. These codes were identified by comparing each category to the official definitions listed in the *Standard Industrial Classification Manual, 1987*, prepared by the Executive Office of the President, Office of Management and Budget. Note that in most cases, the listed SIC category also includes businesses not involved in recycling and reuse. Beginning in 1997 the SIC system will gradually be phased out and replaced by the new *North American Industry Classification System* (NAICS), which is harmonious with systems used in Mexico and Canada, in accordance with the North American Free Trade Agreement. Table A-1 also lists the NAICS codes that correspond to the traditional SIC codes. Where the NAICS categories differ significantly, the new category name is provided. Notable changes in the NAICS system include a new category for material recovery facilities, and a division of SIC 4953, Refuse Systems into separate categories for haulers and disposal facility operators handling hazardous, solid and other wastes.

TABLE A-1
DESCRIPTIONS OF INDUSTRY SEGMENTS AND BUSINESS CATEGORIES OF THE RECYCLING AND REUSE INDUSTRIES

Industry Sector	Business Categories in Sector	Typical SIC Code Assignments	Typical NAICS Code Assignments
Recycling Collection	1. Government Staffed Residential Curbside Collection Programs staffed by municipal, state or other government agencies that provide curbside, drop-off or other recycling collection services. Does not include programs focused on education, market development or other activities not directly supporting collection programs. Does not include municipal programs staffed by private contractors.	4212 Local Trucking Without Storage	562111 Solid Waste Collection (without disposal)
	2. Private Staffed Residential Curbside Collection Private sector establishments that provide recycling collection services to residential waste generators, sometimes under contract to municipal or state government agencies. The primary activity of many of these establishments is waste hauling.	4212 Local Trucking Without Storage	562111 Solid Waste Collection (without disposal)

APPENDIX A

Industry Sector	Business Categories in Sector	Typical SIC Code Assignments	Typical NAICS Code Assignments
Recycling Processing	3. Compost and Miscellaneous Organics Producers Establishments that produce compost, mulch, bark, and other soil amendment or landscaping products from source separated yard trimmings, discarded wood and food, biosolids and other organic feedstocks. This category also includes vermiculture.	2875 Fertilizers (mixing only)	325314 Fertilizers (mixing only)
	4. Materials Recovery Facilities Establishments that accept mixed and/or source separated recyclables, typically from municipal curbside and drop-off collection programs. Activities include sorting, baling, grinding, densifying and/or brokering recyclables for wholesale distribution. May also segregate recyclables from mixed solid waste. This category is intended to be defined consistently with the new NAICS category for materials recovery facilities.	4953 Refuse Systems	56292 Material Recovery Facilities
	5. Recyclable Material Wholesalers Establishments that process recycled materials by sorting, grading, densifying, removing contaminants and otherwise preparing the materials for shipment to manufacturing facilities for use in industrial production, and/or establishments that provide recovered material brokering services. Examples include paper stock dealers and scrap metal processors. These establishments may also provide recycling collection services. This category is intended to be defined consistently with the new NAICS category for recyclable material wholesalers.	5093 Scrap & Waste Material Wholesalers	42193 Recyclable Material Wholesalers
Recycling Manufacturing	6. Glass Container Manufacturing Plants Establishments that produce finished glass containers for shipment to bottlers, using recycled glass cullet as a feedstock. May also undertake beneficiation activities on site.	3221 Glass Containers	327213 Glass Containers
	7. Glass Product Producers (other recycled uses) Establishments that produce products other than containers, using recycled glass as a feedstock. Examples include fiberglass, decorative tiles, glassware, and construction blocks.	3229 Pressed and Blown Glass and Glassware	327212 Pressed and Blown Glass and Glassware
	8. Nonferrous Secondary Smelting and Refining Mills Establishments involved in the recovery and alloying of nonferrous metals. Activities include grading, sorting, detinning, refining, and other processes. Produce intermediate products such as ingot. May also include fabrication of basic products. Note that <u>primary</u> smelters of nonferrous metals, excluding aluminum and copper, process scrap in addition to virgin materials. Primary aluminum and copper smelters do not process scrap.	3341 Secondary smelting and refining of nonferrous metals 3339 Primary smelting and refining of nonferrous metals, except copper and aluminum	331314, 331423, 331492 Miscellaneous Secondary Nonferrous Smelting, Refining and Alloying.
	9. Nonferrous Product Producers Establishments that produce a wide range of intermediate products through extrusion processes, primarily from billet manufactured in smelting operations. Many of these plants may also operate in-house casting operations that process unrefined nonferrous scrap.	3351 - 3356 Miscellaneous Nonferrous Products	331421, 331315, 331315, 331316, 331319 Miscellaneous Nonferrous Products

DESCRIPTION OF RECYCLING AND REUSE BUSINESS CATEGORIES

Industry Sector	Business Categories in Sector	Typical SIC Code Assignments	Typical NAICS Code Assignments
Recycling Manufacturing (Continued)	10. Nonferrous Foundries Establishments that produce castings and die-castings of various nonferrous metals and alloys. Note that many manufacturers of specific end products (e.g., automobiles) may operate foundries and purchase scrap.	3363 - 3369 Nonferrous Foundries	331521 – 331528 Nonferrous Foundries
	11. Paper, Paperboard, and Deinked Market Pulp Mills Establishments that produce first stage intermediate paper and paper board products (e.g., paper rolls) using recovered paper or deinked market pulp as a feedstock. Also includes establishments that deink recovered paper and produce market pulp for sale to paper and paperboard mills.	2621 Paper Mills 2631 Paperboard Mills	322121 Paper Mills (Except newsprint) 322122 Newsprint Mills 322123 Paperboard Mills
	12. Paper-Based Product Manufacturers Establishments that produce paper products other than traditional paper and paperboard products, using discarded paper as a feedstock. Examples include cellulose insulation, molded fiber products, construction board, hydro-seeding mulch or animal bedding.	2679 Miscellaneous Converted Paper and Paperboard Products	322299 Other Converted Paper Product Manufacturing (egg cartons, molded pulp)
	13. Pavement Mix Producers (asphalt and aggregate) Establishments that produce asphalt paving mix and aggregate for use in road construction using recycled pavement, asphalt, rubber modified asphalt and/or glass, in addition to virgin materials.	2951 Asphalt paving mixtures and blocks	324121 Asphalt paving mixtures and blocks
	14. Plastics Reclaimers Establishments that produce plastic pellets or granulated plastic suitable for use by plastics product manufacturers. Activities include separating, washing, grinding, flaking and/or pelletizing. This category also includes establishments that manufacture intermediate products directly from unprocessed recycled plastic, such as plastic lumber products.	3087 Custom Compounding of Purchased Plastics Resins	325991 Custom Compounding of Purchased Plastics Resins
	15. Plastic Converters Establishments that produce intermediate plastic products (e.g., molded products and components, sheet and fiber) using recycled pellets or granulated plastic as a feedstock.	3081 – 3089 Miscellaneous Plastics Products	3261 Plastics Product Manufacturing
	16. Rubber Product Manufacturers Establishments that produce first-stage intermediate products or end products using crumb rubber as a feedstock.	3069 Miscellaneous fabricated rubber products 3011 Tires and inner tubes 3021 Rubber and plastics footwear 3052 Rubber & plastics hose & belting 3053 Gaskets, packing and sealing devices	3262 Rubber Product Manufacturing

APPENDIX A

Industry Sector	Business Categories in Sector	Typical SIC Code Assignments	Typical NAICS Code Assignments
Recycling Manufacturing (Continued)	17. Steel Mills Basic oxygen furnaces (BOF) producing raw steel in various forms using a mix of scrap and molten iron made in blast furnaces from scrap and raw materials (iron ore, coke, limestone) and also electric arc furnaces (EAF) using scrap. Products from EAF mills are primarily slabs, billets or rebar. Products from BOF mills are primarily flat or rolled products. Activities include grading scrap, detinning, refining and product fabrication. Additional fabrication and assembly of final stage products may occur at these facilities.	3312 Steel works, Blast Furnaces and Rolling Mills	331111 Iron and Steel Mills
	18. Iron and Steel Foundries Establishments that produce a wide range of cast steel products using unrefined scrap and steel ingot produced in steel mills. Activities may include grading scrap, refining and casting.	3321 - 3325 Iron and Steel Foundries	331511 – 331513 Iron and Steel Foundries
	19. Other Recycling Processors and Manufacturers Other recycling processors and manufacturers, not elsewhere classified. May include used oil refiners, household hazardous waste processors, agricultural facilities or landscapers using ash or paper mill sludge, engineering applications of tires, and other users of materials not elsewhere classified.	Varied.	Varied.
Reuse and Remanufacturing	20. Computer and Electronic Appliance Demanufacturers Establishments that sort, classify, grade and remanufacture used electronic appliances, primarily computers. Remanufacture may encompass entire appliances or components. These establishments may also recycle materials not suitable for remanufacture.	5065 Electronic Parts, NEC 7378 Computer Maintenance and Repair	421690 Other Electronic Parts & Equipment Wholesale 811212 Computer & Office Machine Repair and Maintenance
	21. Motor Vehicle Parts Establishments that clean, sort, inspect and remanufacture used motor vehicle parts.	5015 Wholesale Used Motor Vehicle Parts	42114 Motor Vehicle Parts (Used) Wholesale
	22. Retail Used Merchandise Sales Establishments that operate retail sales facilities dedicated to reused products. Activities may include providing drop-off or pick-up collection services for used products; cleaning, repairing and otherwise preparing products for resale. Includes “thrift” stores, reusable product depots, reuse centers and product-specific stores such as used clothing and used sporting goods, not elsewhere classified.	5932 Used Merchandise Stores (retail)	45331 Used Merchandise Stores (excluding pawn shops)
	23. Tire Retreaders Establishments that sort, clean, buff and remanufacture used tires by adding new tread. These establishments produce crumb rubber as a by-product.	7534 Tire Retreading and Repair Shops	326212 Tire Retreading

DESCRIPTION OF RECYCLING AND REUSE BUSINESS CATEGORIES

Industry Sector	Business Categories in Sector	Typical SIC Code Assignments	Typical NAICS Code Assignments
Reuse and Remanufacturing (Continued)	24. Wood Reuse Establishments that produce graded lumber and/or finished goods by cleaning, grading, and otherwise processing used wood. Includes establishments that purchase used, damaged pallets and remanufacture for reuse. Does not include establishments whose primary product is fuel.	2448 Wood Pallets and Skids 2499 Wood Products, NEC	32192 Wood Container and Pallet Manufacturing 321999 Wood Products, NEC
	25. Materials Exchange Services Establishments that provide listings and otherwise facilitate the reuse of products and materials, primarily by commercial and industrial establishments.	7389 Business Services NEC	54199 All Other Professional, Scientific, and Technical Services
	26. Other Reuse Establishments not elsewhere classified that purchase used equipment or merchandise and remanufacture, clean and otherwise prepare the used products for distribution.	5082-5084 Wholesale Machinery, Equipment, and Supplies	42181-42183 Wholesale Machinery, Equipment, and Supplies
Support Businesses	27. Recycling and Reuse Equipment Manufacturers and Vendors Establishments that produce the primary equipment used by recycling businesses. Includes all significant equipment used by collection and intermediate processing establishments, such as trucks, balers, conveyors, magnets, automated sortation devices, grinders, choppers, etc. Also includes specialized equipment used specifically to accommodate recycled materials in manufacturing processes, or to process or remanufacture used products. Examples include plastic bottle washing, sorting and pelletizing systems, paper deinking systems, tire processing equipment, glass bottle washing systems, etc. This category does not include standard processing and manufacturing equipment not specifically designed for recycling or reuse.	3511 - 3599 Industrial Machinery and Equipment	333 Machinery Manufacturing
	28. Consulting and Engineering Services Establishments that provide technical research and development services and engineering services to recycling collectors and intermediate processors, and reuse establishments, and that provide specialized services essential to the recycling or reuse process in manufacturing facilities. Examples include engineering services to develop deinking plants, composting facilities and plastics processing facilities. Broad consulting services to government or non-profits that does not directly support establishments listed above are not included.	8733 Noncommercial Research Organizations 8711 Engineering services 8742 Management consulting services	54133 Engineering Services 541611- 541614 Management Consulting Services
	29. Transporters Establishments that transport recovered materials or reusable products to intermediate processing facilities and/or processing and end-use facilities by air, truck, sea or rail.	4011 – 4499 Freight Services	481 – 484 Air, Rail, Water, and Truck Transportation
	30. Other Support Businesses Other support businesses such as accounting firms, janitorial firms, etc.	Various	Various

APPENDIX B DATA SOURCES

Resource Number	Resource/Directory	Source Organization	Types of Data/Businesses Included	Resource Use		How Used
				Survey	Existing Data	
1	<i>Paper Matcher</i>	American Forest & Paper Association	Paper and paperboard mills, paper dealers, recycling centers		✓	Used to estimate percentage of mills consuming recovered paper for existing data adjustments.
2	<i>Wood Recycling Directory - 1996</i>	American Forest & Paper Association	C&D processors, miscellaneous organic products, compost producers	✓		Used for building survey contact list.
3	<i>Handler/Reclaimer Database</i>	American Plastics Council	Plastics handlers, reclaimers		✓	Used to estimate employment and establishments for plastics reclaimers.
4	<i>ARM Directory and Buyers Guide</i>	American Recycling Markets	Collectors, intermediate processors, processors, manufacturers, brokers and equipment dealers	✓		Used for building survey contact list.
5	<i>1998-1999 Directory</i>	Asphalt Recycling and Reclaiming Association	Aggregate producers and pavement mix, specialized reuse and recycling equipment manufacturers, consulting and engineering services	✓		Used for building survey contact list of aggregate and pavement mix producers.
6	<i>Recycling Product News</i>	Baum Publications	Recycling equipment manufacturers	✓		Used for building survey contact list of equipment manufacturers.
7	<i>November 2000 "State of Garbage in America" article</i>	BioCycle Magazine	Curbside recycling information (population with access, programs, and yard waste collection)		✓	Used for estimating recycling collection
8	<i>Glass Marketing Guide</i>	California Integrated Waste Management Board	Glass container and fiberglass manufacturers		✓	Used for estimating throughput for glass product producers (non-container)
9	<i>Manufacturer Database (Access)</i>	Cellulose Insulation Manufacturers Association	Cellulose insulation manufacturers	✓		Used for building survey contact list for paper-based product manufacturers
10	<i>Reuse/Recycling of Glass Cullet for Non-Container Uses</i>	Dane County DPW	Manufacturers of recycled glass products other than containers	✓		Used for building survey contact list for glass product producers (other recycling uses).
11	<i>Product and Equipment Specifications Reports</i>	Downing & Associates	Compost and wood waste, recycling and solid waste equipment manufacturers	✓		Used for building survey contact list for equipment manufacturers.

APPENDIX B

Resource Number	Resource/Directory	Source Organization	Types of Data/Businesses Included	Resource Use		How Used
				Survey	Existing Data	
12	<i>Organics Mailing List</i>	Downing & Associates	Compost and wood waste, recycling and solid waste	✓		3,800 listings, comprehensive source.
13	<i>Markets List</i>	Glass Packaging Institute	Glass beneficiation facilities/Glass container plants; Glass container manufacturing plants	✓		Used for building survey contact list for glass container manufacturing plants.
14	<i>MRF Yearbook</i>	Governmental Advisory Associates	MRFs and mixed waste processing facilities in US	✓		Used for building survey contact list for MRFs.
15	<i>Harris Directory</i>	The Harris Reports	Miscellaneous processing and manufacture, remanufacturing and wholesale sales, materials exchange services (focused on building, interior, garden products). Contains 1,000 records.	✓		Used for building survey contact list for reuse.
16	<i>Lockwood Post Directory of the Pulp Paper and Allied Trades</i>	Miller Freeman Publishing, Inc.	Pulp & paper mills, converting plants, paper merchants/distributors, wastepaper stock suppliers		✓	Used to estimate percentage of mills consuming recovered paper for existing data adjustments.
17	<i>Molded Pulp Product Manufacturers</i>	Molded Pulp Environmental Association	Molded pulp producers	✓		Used for building survey contact list for paper-based product manufacturers.
18	<i>Member List</i>	North American Insulation Manufacturing Association	Fiberglass insulation producers	✓		Used for building survey contact list for glass product producers (other recycling uses).
19	<i>Scrap Tire and Rubber Users Directory</i>	Recycling Research Institute	Tire and rubber recyclers, equipment providers, general info	✓		Used for building survey contact list for rubber product manufacturers.
20	<i>Buyers Guide 1998</i>	Recycling Today Magazine	Equipment manufacturers	✓		Used for building survey contact list for equipment manufacturers.
21	<i>Mailing List</i>	Resource Recycling, Inc	Over 41,000 records in numerous categories	✓		Used for building survey contact list.
22	<i>1996 Directory of U.S. and Canadian Scrap Plastics Processors and Buyers</i>	Resource Recycling, Inc	Commercial recycling collectors and intermediate processors, Plastics processing and manufacture, Specialized reuse and recycling equipment manufacturers, Brokers	✓		Used for building survey contact list.
23	<i>1997-98 Equipment Directory</i>	Resource Recycling, Inc	Recycling collection and intermediate processing equipment manufacturers, specialized reuse and recycling equipment manufacturers	✓		Used for building survey contact list for equipment manufacturers.
24	<i>SPI Economic Report 2000</i>	Society of the Plastics Industry, Inc.	Economic size data on the plastics converting industry		✓	Includes captive plastics conversion data otherwise counted by Census under non-plastics NAICS categories

DATA SOURCES

Resource Number	Resource/Directory	Source Organization	Types of Data/Businesses Included	Resource Use		How Used
				Survey	Existing Data	
25	<i>1998 SMA Membership Directory</i>	Steel Manufacturers Association	Steel mills, Iron and steel foundries, Specialized reuse and recycling equipment manufacturers		✓	Contact and facility information for SMA members; good information on electric arc furnaces.
26	<i>Member List</i>	Used Oil Management Association	Used oil processors	✓		Only five members; National Oil Recyclers Assoc. is a better resource.
27	<i>Regional Accounts Data, Regional Economic Profiles</i>	US Bureau of Economic Analysis	State and national average wage and total jobs data		✓	Used for statewide data to place recycling and reuse data into perspective.
28	<i>Gross State Product in Current Dollars, 1992-1998</i>	US Bureau of Economic Analysis	Gross state and national product data		✓	Used for statewide data to place recycling and reuse data into perspective.
29	<i>Standard Statistical Establishments List (SSEL)</i>	US Census Bureau	Covers all businesses		✓	Good resource for categories with corresponding SIC/NAICS codes.
30	<i>Census of Manufactures</i>	US Census Bureau	Various manufacturing industries		✓	Contains more detail than SSEL on production workers and value added by manufacture for selected industries. Useful for estimates.
31	<i>Current Industrial Reports – Manufacturing Profiles</i>	US Census Bureau	Various manufacturing industries		✓	Contains some data on material throughput. Useful for estimates.
32	<i>1997 Economic Census</i>	US Census Bureau	Covers all businesses		✓	Good resource for categories with corresponding SIC/NAICS codes and national total/average throughput figures.
33	<i>Electronics Reuse and Recycling Directory</i>	US EPA	Electronic appliance demanufacturers. Includes donation, reuse, remanufacture, recycling of computers.	✓		Used for building survey contact list for computer and electronic equipment demanufacturers.
34	<i>Mineral Commodity Reports</i>	US Geological Survey	Ferrous and non-ferrous metals recycling statistics		✓	Used for scrap consumption (throughput) data.
35	<i>1997 WASTEC Products and Services Directory</i>	Waste Equipment Technology Association	Recycling collection and intermediate equipment processing manufacturers, specialized reuse and recycling equipment manufacturers, Consulting and engineering services	✓		Used for building survey contact list for equipment manufacturers.
36	<i>Resource 1998</i>	Waste News	Equipment guide, waste focus	✓		Used for building survey contact list for equipment manufacturers.

APPENDIX B

Resource Number	Resource/Directory	Source Organization	Types of Data/Businesses Included	Resource Use		How Used
				Survey	Existing Data	
37	<i>1997 World Wastes Buyers' Guide Edition</i>	World Wastes	Collectors and intermediate processors, Recycling collection and intermediate processing equipment manufacturers, Specialized reuse and recycling equipment manufacturers	✓		Used for building survey contact list for equipment manufacturers.
38	<i>Recycling Directory</i>	Yellow Page Publishers Association (YPPA)	Commercial recycling centers and intermediate processors, Paper processing and manufacture, Brokers which deal with old directories	✓		Used for building survey contact list for paper-based product manufacturers.

APPENDIX C

SAMPLE OF DATA FROM U.S. CENSUS BUREAU'S ECONOMIC CENSUS

California

1997

Issued April 2000

EC97M31A-CA

1997 Economic Census

Manufacturing

Geographic Area Series



U.S. CENSUS BUREAU

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Economics and Statistics Administration
U.S. CENSUS BUREAU



Table 1. Industry Statistics for the State: 1997—Con.

[Includes data for industry groups and industries with 100 employees or more. For information on geographic areas followed by * and explanation of terms, see appendixes. For meaning of abbreviations and symbols, see introductory text]

NAICS code	Geographic area and industry	E ¹	All establishments		All employees		Production workers			Value added by manufacture (\$1,000)	Cost of materials (\$1,000)	Value of shipments (\$1,000)	Total capital expenditures (\$1,000)
			Total	With 20 em- ploy- ees or more	Number ²	Payroll (\$1,000)	Number	Hours (1,000)	Wages (\$1,000)				
31-33	CALIFORNIA—Con.												
	Manufacturing—Con.												
326	Plastics & rubber products mfg—Con.												
3262	Rubber product mfg	1	299	105	10 108	277 328	7 862	15 515	172 635	719 003	683 821	1 412 968	45 440
32621	Tire mfg	—	78	15	1 855	63 328	1 364	2 895	43 620	166 409	245 606	415 452	19 686
326211	Tire mfg (except retreading)	—	10	5	962	42 357	798	1 715	32 292	128 124	172 727	304 305	D
326212	Tire retreading	1	68	10	893	20 971	566	1 180	11 328	38 285	72 879	111 147	D
32622	Rubber & plastics hoses & belting mfg	—	22	10	832	22 871	691	1 342	15 256	64 559	63 828	131 795	4 888
326220	Rubber & plastics hoses & belting mfg ..	—	22	10	832	22 871	691	1 342	15 256	64 559	63 828	131 795	4 888
32629	Other rubber product mfg	2	199	80	7 421	191 129	5 807	11 278	113 759	488 035	374 387	865 721	20 866
326291	Rubber product mfg for mechanical use	1	78	32	3 118	80 422	2 549	5 148	50 964	196 139	89 902	285 770	6 797
326299	All other rubber product mfg	2	121	48	4 303	110 707	3 258	6 130	62 795	291 896	284 485	579 951	14 069
327	Nonmetallic mineral product mfg	1	1 565	527	42 748	1 409 102	32 856	66 491	986 415	4 123 989	3 352 041	7 490 412	344 969
3271	Clay product & refractory mfg	2	273	95	6 967	167 806	5 340	10 330	110 495	375 728	173 159	552 088	26 427
32711	Pottery, ceramics, & plumbing fixture mfg ...	2	204	69	5 497	129 795	4 180	8 180	85 684	285 399	125 774	409 818	21 601
327111	Vitreous china plumbing fixture & bathroom accessories mfg	1	11	5	652	16 557	512	1 113	13 659	35 441	14 927	50 233	2 805
327112	Vitreous china, fine earthenware, & other pottery product mfg ..	3	168	52	3 984	78 971	2 960	5 491	50 095	184 701	84 042	267 379	12 837
327113	Porcelain electrical supply mfg	—	25	12	861	34 267	708	1 576	21 930	65 257	26 805	92 206	5 959
32712	Clay building material & refractories mfg	2	69	26	1 470	38 011	1 160	2 150	24 811	90 329	47 385	142 270	4 826
327121	Brick & structural clay tile mfg	—	15	6	461	13 794	349	657	8 279	37 048	11 061	47 753	1 653
327122	Ceramic wall & floor tile mfg	8	32	8	471	9 989	400	655	7 318	17 710	8 844	26 878	2 050
327123	Other structural clay product mfg	—	11	8	413	10 732	314	671	6 961	26 123	16 643	46 892	872
327124	Clay refractory mfg ...	1	10	4	c	D	D	D	D	D	D	D	D
3272	Glass & glass product mfg .	—	320	72	9 791	343 678	7 946	16 086	258 126	1 034 750	683 654	1 715 670	65 312
32721	Glass & glass product mfg	—	320	72	9 791	343 678	7 946	16 086	258 126	1 034 750	683 654	1 715 670	65 312
327211	Flat glass mfg	—	5	5	1 189	53 025	970	2 184	41 044	242 014	111 207	354 500	2 986
327212	Other pressed & blown glass & glassware mfg	3	83	4	830	25 313	665	1 217	18 905	86 513	27 330	113 422	7 324
327213	Glass container mfg ..	—	8	8	3 348	136 544	3 011	6 182	117 144	428 602	297 986	724 192	30 582
327215	Glass product mfg made of purchased glass	1	224	55	4 424	128 796	3 300	6 503	81 033	277 621	247 131	523 556	24 420
3273	Cement & concrete product mfg	1	673	271	18 306	640 391	13 769	28 014	443 681	1 894 136	1 787 110	3 686 150	190 441
32731	Cement mfg	—	31	15	1 927	93 795	1 461	3 118	66 434	486 760	354 774	846 898	66 207
327310	Cement mfg	—	31	15	1 927	93 795	1 461	3 118	66 434	486 760	354 774	846 898	66 207
32732	Ready-mix concrete mfg.	2	387	145	8 157	296 490	6 216	12 460	216 791	786 002	982 105	1 770 250	69 065
327320	Ready-mix concrete mfg	2	387	145	8 157	296 490	6 216	12 460	216 791	786 002	982 105	1 770 250	69 065
32733	Concrete pipe, brick, & block mfg	2	84	42	2 449	76 108	1 726	3 462	45 375	179 000	150 260	328 010	10 940
327331	Concrete block & brick mfg	3	49	21	1 177	34 015	754	1 603	17 841	93 746	82 192	176 146	4 366
327332	Concrete pipe mfg	1	35	21	1 272	42 093	972	1 859	27 534	85 254	68 068	151 864	6 574
32739	Other concrete product mfg	1	171	69	5 773	173 998	4 366	8 974	115 081	442 374	299 971	740 992	44 229
327390	Other concrete product mfg	1	171	69	5 773	173 998	4 366	8 974	115 081	442 374	299 971	740 992	44 229
3274	Lime & gypsum product mfg	—	48	19	1 714	66 414	1 358	3 000	43 779	190 403	262 570	459 229	17 237
32741	Lime mfg	—	4	1	122	4 911	103	205	3 929	11 412	7 400	18 477	D
327410	Lime mfg	—	4	1	122	4 911	103	205	3 929	11 412	7 400	18 477	D
32742	Gypsum product mfg.	—	44	18	1 592	61 503	1 255	2 795	39 850	178 991	255 170	440 752	D
327420	Gypsum product mfg.	—	44	18	1 592	61 503	1 255	2 795	39 850	178 991	255 170	440 752	D

APPENDIX D

SURVEY MATERIALS



October 12, 2000

Bill Camarillo
Chief Financial Officer
California Wood Recycling
2950 Johnson Drive #101
Ventura, CA 93003

Subject: **U.S. Recycling Economic Information Study**

Dear Colleague:

We are writing to ask your assistance in responding to the enclosed, brief survey. This important survey is designed to gather key economic statistics on the nation's recycling and reuse industries.

The survey requests information about your firm's activities involving the processing of recyclable and reusable materials/products, manufacturing of new products from recycled materials, or manufacturing equipment used in the recycling and reuse industries. Additional survey forms have been enclosed if you have more than one facility. (Please use a separate form for each facility.) We want to emphasize that **the information you provide will be held strictly confidential – under no circumstances will company-specific data be released**. Your responses will be aggregated with data provided by other businesses, and only released as aggregated, statewide or industry-wide totals.

Our organizations, the California Integrated Waste Management Board (CIWMB) and the National Recycling Coalition (NRC), have retained R. W. Beck, Inc., a nationally recognized management consulting firm, to conduct the first ever U.S. Recycling Economic Information Study. As part of the study, R. W. Beck is surveying businesses like yours from throughout the nation.

Once the study is complete, the CIWMB and NRC will publish the study results and use them to promote the growth of the recycling and reuse industries. By sharing aggregate statistics with the financial community, the information will be used to help leverage the availability of capital to assist recycling entrepreneurs grow their businesses. By targeting state and federal officials, the information will help secure government action (or inaction) favorable to recycling and reuse businesses. The information will also be useful in educating the general public about the benefits your industry provides to our economy and environment.

If you have any questions regarding the enclosed survey form, please contact Tim Buwalda of R. W. Beck at (800) 873-6532. If you wish, you may fax your completed survey to R. W. Beck at (407) 648-8382. We would appreciate a response by October 27, 2000. Thank you for your assistance.

Sincerely,

Linda Moulton-Patterson
Chair,
California Integrated Waste Management Board

Will Ferretti
Executive Director,
National Recycling Coalition

U. S. Recycling Economic Information Study

<i>Company</i> <i>Subsidiary of</i> <i>Mailing Address</i> <small>(location where contact can be reached)</small>	California Wood Recycling 2950 Johnson Drive #101 Ventura, CA 93003	
<i>Physical Address</i> <small>(establishment location)</small> <i>Establishment Telephone Number</i>	3450-A Auto Center Dr Ventura, CA 93003 (805) 650-1616 <i>Ext</i> _____ <small>Please provide at least an area code that corresponds to the PHYSICAL ADDRESS.</small>	
<i>Contact Name</i> <i>Title</i> <i>Contact Telephone Number</i> <i>Fax Number</i> <i>E-mail Address</i>	Bill Camarillo Chief Financial Officer (805) 650-1616 <i>Ext</i> _____ (805) 650-9630 Bill@agromin.com	Be sure that the ZIP CODE for the physical address is NOT for a Post Office Box. If you have any questions about this form or the U. S. Recycling Economic Information Study, please call Tim Buwalda of R. W. Beck at (800) 873-6532.

♦ Please make any necessary changes and spelling corrections to the information above.

♦ Our records show that you also have facilities at the following location(s):

Erwindale CA Simi Valley CA Sylmar CA

♦ If we are missing one or more of your facilities, please list them below.

A. Name _____ B. Name _____ C. Name _____
City/State _____ City/State _____ City/State _____

U. S. Recycling Economic Information Study

CONFIDENTIAL SURVEY — no establishment-specific data will be released.



National
Recycling
Coalition
Inc.

1. Please identify the categories that best match your establishment (check all that apply). Please complete a separate form for each location you have (make extra copies if needed).

ESTABLISHMENT CATEGORIES

Recycling Collection		Code	Reuse and Remanufacturing		Code
<input type="checkbox"/>	Government-staffed collection	18	<input type="checkbox"/>	Computer/electronic appliance demanufacturer	12
<input type="checkbox"/>	Private-staffed collection	19	<input type="checkbox"/>	Equipment or toner cartridge remanufacturer	28
Recycling Processing and Manufacturing			<input type="checkbox"/>	Motor vehicle parts remanufacturer	29
<input type="checkbox"/>	Compost/organics processor	1	<input type="checkbox"/>	Repair shop	30
<input type="checkbox"/>	Fiberglass insulation producer	2	<input type="checkbox"/>	Retail used merchandise sales	31
<input type="checkbox"/>	Glass container manufacturing plant	3	<input type="checkbox"/>	Tire retreader	32
<input type="checkbox"/>	Glass product producer (other recycled uses)	4	<input type="checkbox"/>	Wood reuse or pallet rebuilder	13
<input type="checkbox"/>	Household hazardous waste processor	5	Support Businesses		
<input type="checkbox"/>	Materials recovery facility (commingled matls.)	6	<input type="checkbox"/>	Broker	33
<input type="checkbox"/>	Nonferrous product producer	20	<input type="checkbox"/>	Consulting/engineering company	34
<input type="checkbox"/>	Nonferrous foundry	21	<input type="checkbox"/>	Materials exchange services	14
<input type="checkbox"/>	Nonferrous smelting or refining mill	22	<input type="checkbox"/>	Recycling and reuse equipment manufacturer	15
<input type="checkbox"/>	Oil processor	7	<input type="checkbox"/>	Transporter	35
<input type="checkbox"/>	Paper, paperboard, or market pulp mill	23	Other (describe below)		
<input type="checkbox"/>	Paper-based product mfg. (e.g. insulation, bedding)	8	<input type="checkbox"/>	Other recycling processor/manufacturer	16
<input type="checkbox"/>	Pavement mix producer (asphalt or aggregate)	9	<input type="checkbox"/>	Other reuse/remanufacturer	17
<input type="checkbox"/>	Plastics converter	24	<input type="checkbox"/>	Other (none of the above)	36
<input type="checkbox"/>	Plastics reclaimer	10	Describe your establishment here:		
<input type="checkbox"/>	Recyclable materials processors (e.g. paper, metal)	25			
<input type="checkbox"/>	Rubber product manufacturer	11			
<input type="checkbox"/>	Steel or Iron foundry	26			
<input type="checkbox"/>	Steel mill	27			

2. If you placed a check mark by a category numbered from:

- **1-17**, please continue and complete the remaining three questions on the next page as they apply to your establishment as a recycling, manufacturing (using recycled materials), reuse, or recycling equipment manufacturer. Those questions are not intended to quantify in-house programs that reuse products or recover self-generated scrap materials.

If you checked two or more categories, please select a single category number from 1-17 that best represents the primary recycling, manufacturing (using recycled materials), reuse, or recycling equipment manufacturing activities conducted by your establishment.

Please write the establishment category code (1-17) this form is being completed for here: ____

- **18-36** you may stop and return this survey in the postage-paid envelope. Thank you!

U. S. Recycling Economic Information Study

CONFIDENTIAL SURVEY — no establishment-specific data will be released.



National
Recycling
Coalition
Inc.

3. Establishment Size Information (total this location):

Total Number of Employees:	Most Recent Total Annual Payroll: ^[1]	Most Recent Total Annual Receipts: ^[2]
<input type="checkbox"/> 0 – 9	<input type="checkbox"/> \$0 - \$49,999	<input type="checkbox"/> \$0 - \$99,999
<input type="checkbox"/> 10 – 24	<input type="checkbox"/> \$50,000 - \$99,999	<input type="checkbox"/> \$100,000 - \$249,999
<input type="checkbox"/> 25 – 49	<input type="checkbox"/> \$100,000 - \$149,999	<input type="checkbox"/> \$250,000 - \$499,999
<input type="checkbox"/> 50 – 99	<input type="checkbox"/> \$150,000 - \$499,999	<input type="checkbox"/> \$500,000 - \$999,999
<input type="checkbox"/> 100 – 199	<input type="checkbox"/> \$500,000 - \$999,999	<input type="checkbox"/> \$1,000,000 - \$2,499,999
<input type="checkbox"/> 200 – 299	<input type="checkbox"/> \$1,000,000 - \$2,499,999	<input type="checkbox"/> \$2,500,000 - \$4,999,999
<input type="checkbox"/> 300 – 399	<input type="checkbox"/> \$2,500,000 - \$4,999,999	<input type="checkbox"/> \$5,000,000 - \$7,499,999
<input type="checkbox"/> 400 – 499	<input type="checkbox"/> \$5,000,000 - \$9,999,999	<input type="checkbox"/> \$7,500,000 - \$9,999,999
<input type="checkbox"/> 500 – 1,000	<input type="checkbox"/> \$10,000,000 - \$19,999,999	<input type="checkbox"/> \$10,000,000 - \$19,999,999
_____ Please fill in	<input type="checkbox"/> \$20,000,000 - \$30,000,000	<input type="checkbox"/> \$20,000,000 - \$49,999,999
value if greater than 1,000	\$_____ Please fill	<input type="checkbox"/> \$50,000,000 - \$74,999,999
	in value if greater than \$30,000,000	<input type="checkbox"/> \$75,000,000 - \$100,000,000
		\$_____ Please fill
		in value if greater than \$100,000,000

[1] Payroll includes total salary, hourly pay, bonuses, commissions, sick-leave pay, free meals, and benefits received by employees.

[2] Receipts include revenue of all forms (sales, fees, rents, commissions, interest, dividends) minus all local, state, and federal tax revenue collected.

4. Covered Activities Information (this location):

<p>"Covered activities" are all activities that support:</p> <ul style="list-style-type: none"> Transforming scrap materials or products into a recycled raw material Transforming recycled raw materials into a first intermediate product (e.g. sheet, fiber, roll) Transforming recycled raw materials directly into a finished product Preparing used products for reuse Manufacturing equipment for the recycling or reuse industries <p>Covered activities <u>do not</u> include converting a first intermediate product to finished products or preparing materials for fuel use.</p>	<p>Percent of Total Production Labor Time Spent on Covered Activities:</p> <p><input type="checkbox"/> 0 - 9%</p> <p><input type="checkbox"/> 10 - 19%</p> <p><input type="checkbox"/> 20 - 29%</p> <p><input type="checkbox"/> 30 - 39%</p> <p><input type="checkbox"/> 40 - 49%</p> <p><input type="checkbox"/> 50 - 59%</p> <p><input type="checkbox"/> 60 - 69%</p> <p><input type="checkbox"/> 70 - 79%</p> <p><input type="checkbox"/> 80 - 89%</p> <p><input type="checkbox"/> 90 - 100%</p>	<p>Percent of Total Receipts from Products of Covered Activities:</p> <p><input type="checkbox"/> 0 - 9%</p> <p><input type="checkbox"/> 10 - 19%</p> <p><input type="checkbox"/> 20 - 29%</p> <p><input type="checkbox"/> 30 - 39%</p> <p><input type="checkbox"/> 40 - 49%</p> <p><input type="checkbox"/> 50 - 59%</p> <p><input type="checkbox"/> 60 - 69%</p> <p><input type="checkbox"/> 70 - 79%</p> <p><input type="checkbox"/> 80 - 89%</p> <p><input type="checkbox"/> 90 - 100%</p>
---	--	---

If your establishment code is 1-11, please complete the following table (Question 5).

5. Recycling or Recycled Product Manufacturing Annual Processing Information (this location):

Input Materials	Unit of Measure	Input Quantity	Process Outputs		
			Residue Disposed	Prepared or used for fuel	Recycled product or material
Example — oil	gallons	1,000,000	5%	75%	20%
Paper					
Plastics					
Glass					
Metals					
Tires or rubber					
Construction & demolition debris ^[1]					
Organics ^[2]					
Oil or household hazardous waste					
Other					

[1] Includes concrete, asphalt, non-yard wood waste, etc. from construction, demolition, and remodeling of roads and structures.

[2] Includes yard waste, food waste, sludge, land-clearing debris and wood waste including pallets, brush, stumps/tree trunks, sawdust, and mill scrap.

Thank you for completing this survey! Please return it to R. W. Beck in the postage-paid envelope.

Appendix E

Analysis of Survey Results

The statistical analysis of the survey data provided by establishments that completed surveys identified the recycling characteristics of the average establishment in each of the twelve survey business categories. These averages were then applied to all recycling and reuse establishments in each survey category to estimate the total number of employees²³ and dollar value of payroll and receipts.

Survey information was solicited from 1,081 establishments, all those in one of the twelve survey categories. Data obtained from 183 establishments formed the basis of the statistical analysis. Because many of the establishments initially included in the database were found to have been misclassified or gone out of business, it was necessary to re-estimate the number of establishments in each survey category before extrapolating average statistical data. In California, 470 establishments are believed to be involved in recycling activities in the twelve survey categories.

The procedure for estimating the total number of establishments in each category consisted of several steps. First, businesses in the database that were randomly selected to be surveyed were sent a survey in the mail, followed-up with several telephone calls if they failed to respond to the mailing. Those that were unrelated, unreachable, duplicate, or out of business were eliminated. Those businesses that were either completely or partially responsive to the survey, as well as those that declined to participate or were uncooperative were counted. Further adjustments were made for businesses that changed from one category to another.

The following example will illustrate the procedure used to develop the final estimate of 162 establishments in category 3, compost and organics processors:

- From the initial list of 311 establishments that were classified as potentially being compost and organics processors, a random sample of 295 was contacted;
- Of these 295, 15 establishments moved out of this recycling category into other categories and 146 were eliminated (unrelated, unreachable, duplicate entries, or out of business) – furthermore, 19 moved into the category (from other categories) – resulting in 153 establishments in this category.
- To these 153, we added 9 establishments, based on the observed “success” rate of the attempted sample and the relative amount of establishments that moved into the category, for a total of 162 establishments.²⁴

For each variable (employment, payroll, and receipts), the sample mean, standard deviation, and other related statistics were calculated. Based on the sample size and estimate of the total number of establishments engaged in recycling in this business category, ranges were constructed that should contain the true average value for the typical recycling business in the category.²⁵ Finally, by multiplying this range by the estimate of the total number of recycling businesses in the category, we obtain a range for the total values for each variable.

Continuing with the previous example, the analysis was as follows:

²³ Employee responses were adjusted to a full-time equivalent basis. Thus, two employees each working 50% on recycling activities would be counted as one employee.

²⁴ Of the 58 establishments we attempted to contact in this category, only 27 correctly belonged in the category. We applied this 47% “success” ratio to the 2,168 establishments not contacted of the originally estimated 2,226 establishments, adding 1,009 establishments. Furthermore, we added another 30 establishments through allocation from the group of establishments not surveyed, based on the relative proportion of surveyed establishments that were originally classified in another category but properly belonged in the compost and organics producers category.

²⁵ Technically speaking, these ranges can be described as 95% confidence intervals.

- 90 responses were usable of the 162 establishments that were surveyed and identified as belonging in the category;
- Average number of employees, payroll, and receipts for these 90 responses was calculated;
- Standard deviations and other related statistics necessary to determine a 95% confidence interval for the average of all establishments in this business category was calculated; and
- The low, average, and high values for the confidence interval were then multiplied by the estimated total establishments in this category (162) to yield the estimated range of the total number of employees, payroll, and receipts.

To finish this particular example, the sample of 90 establishments employed (on average) 12 persons per establishment in recycling activities on a full-time equivalent basis. However, given the sample size and the estimate of the total number of establishments in this business category, the actual average number of employees per establishment might range from a low of 9.61 to a high of 13.75. Thus, while 1,892 employees are expected to be involved in recycling activities for the entire set of 162 establishments in this business category, there may be as few as 1,557 or as many as 2,227.

Another point should also be made regarding small population sampling as it applies to certain categories. Given the small number of total establishments engaged in certain business categories, the low end of the estimates is often constrained by the fact that it cannot be less than the value already observed in the sample itself. For example, this is the case for glass product producers where, for example, the expected value of 697 total employees is bounded by a low estimate of 619 because it is already known, through survey data, that 619 employees work for the establishments sampled in this category. As this issue affects the results, it serves to make certain estimates more accurate than would otherwise be possible.

Appendix F

Glossary of Terms

AF&PA – American Forest & Paper Association.

All Other Employees – Non-production employees including those engaged in factory supervision above the line-supervisor level. It includes sales (including driver-salespersons), sales delivery (highway truck drivers and their helpers), advertising, credit, collection, installation and servicing of own products, clerical and routine office functions, executive, purchasing, financing, legal, personnel (including cafeteria, medical, etc.), professional, and technical employees.

Annual Payroll – Total annual payroll includes all forms of compensation, such as salaries, wages, commissions, bonuses, vacation allowances, sick-leave pay, and the value of payments in kind (e.g., free meals and lodgings) paid during the year to all employees.

APC – American Plastics Council.

Covered Activities – Defined as all activities that support:

- Transforming pre-consumer scrap materials or post-consumer products into a recycled material;
- Transforming recycled materials into a first intermediate product (e.g., sheet, fiber, roll);
- Transforming recycled materials directly into a finished product;
- Preparing used products for reuse; and
- Manufacturing equipment for the recycling or reuse industries.

Covered activities *do not* include converting a first intermediate product to finished or semi-finished products or preparing materials for fuel use.

Direct Effects – Refers to the operational characteristics of the firms or institutions that are studied. This study measured the apparent value of twenty-six categories of recycling and reuse establishments. The direct output of these entities is, therefore, their reported gross sales. The direct jobs are the jobs that the firms that were surveyed in the states listed. The direct personal income contains their reported payments to all employees, plus an additional estimate of benefit values and of returns to sole proprietors. The estimate of benefit values and returns to sole proprietors were based on industrial averages in industries that are similar to the recycling and reuse industries included in this study.

Employment – Employment consists of paid full and part-time employees (counted at equal weight), including salaried officers and executives of corporations. Included are employees on sick leave, holidays, and vacations; not included are volunteers, proprietors and partners of unincorporated businesses.

Establishment – A single physical location where business is conducted or where services or industrial operations are performed. Establishments may government operated as well as privately operated.

GPI – Glass Packaging Institute.

I-O – Input-Output, in relation to economic modeling, refers to econometric models that are based on inter-industrial accounts data that identify the products made within a region and the products consumed by industries and households in that same region. Any industry's or institution's output (usually its gross sales) requires inputs in the form of employees, materials, utilities, capital investments, financing, maintenance, equipment, and services. The probability that a firm purchases its inputs locally is estimated in the I-O model.

Indirect Effects – A measurement of the value of additional economic demands that direct firms or institutions place on supplying industries in a region under study. When firms produce goods or conduct business or when public entities provide public goods or services, they must make many purchases. Some of these are from suppliers in the area. Some are not. Public utilities, communications systems, fuel, wholesale goods and services, manufactured goods, financial and legal services, raw and processed commodities, and a variety of professional services are necessary to produce the output of direct establishments.

IMPLAN – A basic input-output economic modeling program used in this study that is published by the Minnesota IMPLAN Group, Inc.

Induced Effects – These effects accrue when workers in direct and indirect industries spend their earnings on goods and services in the region. Induced effects can also be called household effects, and the terms are often used interchangeably. When workers in direct and indirect industries purchase goods and services for household consumption, they, in turn, stimulate another layer of the economy. Most induced activity accrues to retail, services, finance, insurance, and housing spending. Because employment is stimulated in these industries as well, *their* demands for inputs increase, yielding an additional round or additional rounds of indirect purchases and additional rounds of induced activity.

ISRI – Institute of Scrap Recycling Industries.

Jobs – The number of paid full- and part-time positions (counted at equal weight), not the number of full time equivalents.

Multiplier or Multiplier Effect – A term used when referring to economic effects or economic impacts. There are different kinds of multipliers -- this study reports two types. The *Type I* multiplier identifies the value of direct and indirect transactions -- e.g., the output of a business category and all other output that it purchases from its suppliers in the region -- relative to the value of only the direct transactions. The *Type II* multiplier identifies the value of all economic transactions (direct, indirect, and induced) that are stimulated in the economy by an industry under study, including the personal spending of employees throughout the supply chain whose economic activity is apportioned to the industry, relative to the value of only the direct transactions.

NAICS – North American Industrial Classification System, a new system introduced by the U.S. Department of Commerce, Bureau of the Census, in 1997 to classify businesses by their primary industrial activity. It replaces the SIC system and is compatible with systems used in Canada and Mexico.

NERC – Northeast Recycling Council.

Own-Source – Means revenues collected through the state revenue system and not received, for example, as a state disbursement of funds collected through the federal revenue system.

Payroll – Includes the wages and salaries of employees before taxes or other deductions are taken (includes paid vacation, bonuses, commissions, etc.). Does not include employer-paid benefits such as social insurance match, retirement, and medical benefits.

Personal Income – Includes the wages and salaries of employees and proprietors, normal profits to sole proprietors, and an estimate of the cash value of all benefits (e.g., social insurance, retirement, and medical benefits).

Production Workers – Workers (up through the line-supervisor level) engaged in fabricating, processing, assembling, inspecting, receiving, storing, handling, packing, warehousing, shipping (but not delivering), maintenance, repair, janitorial and guard services, product development, auxiliary production for plant's own use (e.g., power plant), record-keeping, and other services closely associated with these production operations at the

establishment covered by the report. Employees above the working-supervisor level are excluded from this item.

Receipts – Receipts (net of taxes) are defined as the revenue for goods produced, distributed, or services provided, including revenue earned from premiums, commissions and fees, rents, interest, dividends, and royalties. Receipts exclude all revenue collected for local, state, and federal taxes.

REI – Recycling Economic Information.

SIC – Standard Industrial Classification, a classification system used by the U.S. Census Bureau to identify businesses by their primary industrial activity.

SPI – Society of the Plastics Industry.

SRI – Steel Recycling Institute.

SSEL – Standard Statistical Establishment List, a database of economic data maintained by the U.S. Census Bureau.

Total Economic Effects – The sum of direct, indirect, and induced effects. They are all of the transactions attributable, either directly or indirectly, to the activities of establishments in the business categories included in this study.

Total Industrial Output – For most private industries this is simply gross sales. For public or quasi-public institutions this normally includes all public outlays, along with the value of government sales and other subsidies received, to isolate the current economic value of their output to the citizens or the area served.

USGS – U.S. Geological Survey.

Value Added – A measure of gross regional product. It includes all personal income (employment compensation, incomes to sole proprietors) plus property incomes (dividends, interests, and rents), and indirect tax payments (primarily excise and sales taxes paid by individuals to businesses).